SIEMENS

# Service manual

## DC190/195 Defibrillator

Service Manual Part No. 086274
Revised 9-91

**Siemens Burdick, Inc.** 15 Plumb Street Milton, WI U.S.A. (608) 868-6000

**TO RESPONSIBLE SERVICE PERSONNEL**

The contents of this document are not binding. If any significant differences between the product and this document are encountered regarding service work, contact Siemens Burdick for further information.

We reserve the right to modify products without amending this document or advising the user.

We recommend using authorized Siemens Burdick personnel for all service and repairs, and the use of Siemens Burdick exchange parts or genuine spare parts. Siemens Burdick will not otherwise assume responsibility for the materials used, the work performed, or for any possible consequences thereof.

**CAUTION**

The DC-190 Defibrillator is an AC-line operated instrument. Activation can only be accomplished when the unit is connected to an AC power source.

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**Federal law restricts the sale of this device for use by or on the order of a physician or any other practitioner licensed by the law of the state in which he practices to use or order the use of this device.**

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# PART I

## CAUTION

THE DC-190 DEFIBRILLATOR IS AN AC-LINE POWERED INSTRUMENT. ACTIVATION CAN ONLY BE ACCOMPLISHED WHEN THE UNIT IS CONNECTED TO AN AC POWER SOURCE.

Controversy exists among medical experts concerning the delivery of defibrillator energy in excess of 320 joules or the storage of energy in excess of 400 joules.

Numerous papers have been written concerning this matter. The following references may be consulted for more information.


**Geddes, L.A., Tacker, W.A., Rosborough, J.P., Moore, A.G., and Cabler, P.S., Electrical Dose for Ventricular Defibrillation of Large and Small Subjects using Precordial Electrodes, J. Clin. Invest. 53:310-319, 1974.**

**Partridge, J.F., Adgey, A.A.J., Webb, S.W., and Anderson, J., Electrical Requirements for Ventricular Defibrillation. Brit. Med. J. 2:313-315, 1975.**

**Tacker, W.A., Jr., Electrical Dose for Defibrillation. Proceedings of Cardiac Defibrillator Conference, October 1-3, 1975. Biomedical Engineering Center, Purdue University, West Lafayette, Indiana. p. 121.**

**Lappin, H.A., Ventricular Defibrillation in Heavy Patients. N. Engl. J. Med. 291;153, 1974.**

**Gutgesell, H.P., Pediatric-Defibrillation. Proceedings of Cardiac Defibrillator Conference, October 1-3, 1975. Biomedical Engineering Center, Purdue University, West Lafayette, Indiana. p. 65.**

**Tacker, W.A., Galioto, F.M., Giuliani, E., Geddes, L.A., and McNamara, D.G., Energy Dosage for Human Trans-Chest Electrical Ventricular Defibrillation. N. Engl. J. Med. 290;215-15, 1974.**


## USER RESPONSIBILITY

The DC-190 Defibrillator will perform in conformity with this manual when operated, maintained and repaired in accordance with instructions provided. This product must be checked periodically. A defective product should not be used. Parts that are broken, missing, plainly worn, distorted or damaged should be replaced immediately. This product or any of its parts should not be repaired other than in accordance with written instructions provided by Burdick or an authorized Burdick Dealer. The user of this product shall have the sole responsibility for any malfunction which results from improper use, faulty maintenance, improper repair, damage, or alteration by anyone other than Burdick, an authorized Burdick Dealer, or person specifically trained by Burdick in the proper repair of this product.

## UNPACKING & INSPECTION

Your Burdick DC-190 Defibrillator has been thoroughly tested and inspected prior to shipment from the factory. We recommend that you inspect this instrument immediately on receipt for any damage that may have occurred during shipment. If there is evidence of damage, do not destroy the shipping carton. Contact the delivery agent immediately and arrange for an inspection and issuance of a concealed damage report.

Any shortage of parts or accessories should be reported to your Burdick Dealer or to Burdick Corporation, Milton, WI 53563.

**NOTE: The maximum energy output for the DC-190 is 400 joules for units with serial numbers up to and including 10,000. Units with serial numbers above 10,000 have a maximum energy output of 360 joules and include a 50 joule energy limit for serialized internal paddles.**

# SPECIFICATIONS FOR DC-190 DEFIBRILLATOR

POWER

**Line Operation:** 105-130V, 50-60Hz, 118 watts at 1.5 amps maximum (during defibrillator charge cycle only).

**Line Operation at 210-260 Volts** -- The unit will operate at 210-260V, 50-60Hz, 118 watts at .75 amps maximum. The change to 210-260 volts is accomplished by changing the position of a jumper wire on the Line Converter PC board and replacing the line fuse with a 1/16 amp slow blow fuse. Labeling at the fuse-holder will also change.

**Isolated Circuits**

105-130V Model:

Paddles: Less than 10 microamps
Chassis: Less than 40 microamps
Defibrillation buttons: Not measurable

210-260V Model:

Paddles: Less than 10 microamps
Chassis: Less than 20 microamps
Defibrillation buttons: Not measurable

**Wave Form** -- Edmark type.

**Energy Control** -- Knob with detented positions at 5, 10, 20, 35, 50, 100, 200, 300, and 400 (360) joules. Energy level accuracy ±5%. Load effects -13% at 25 ohms, +8% at 100 ohms. OFF position disconnects circuit from power. Rotation of knob disarms any charge in unit.

**Disarm** -- Internal relay and load disarms any charge with a time constant of .084 seconds. Circuit is activated any time: 1) delivered energy selector knob is rotated, 2) unit loses power, 3) unit is turned off, 4) control circuits malfunction, 5) defibrillate cycle is completed.

**Charge Control** -- Charge button initiates charge cycle. Further activations have no effect until defibrillation cycle is completed. Internal lamp lights button when charged to level selected by delivered energy selector and a buzzer sounds. When energy is delivered or unit disarmed, light and buzzer sound.

**Charge Time** -- Ready light lights in less than 1 second for levels of 5 to 20 joules, about 2½ seconds for 100 joules, and less than 10 seconds for 400 (360) joules.

**Power Pilot Light** -- Lights when selector is rotated to any position other than off.

**Paddle Defibrillate Switches** -- A button on each external paddle must be depressed together to defibrillate. Unit will not defibrillate until charged and ready light is on. Unit is inhibited when synchronizer is used until R-wave is detected.

**Shorted Paddles Discharge** -- Unit is designed to take extra stress of shorted paddle or open paddle discharge (at low joule setting).

**Weight** -- 27 lbs. (12.25kg.) with accessories.

**Size** -- 16¼" (41.3cm) wide, 16¾" (42.5cm) deep, 6⅝" (16.8cm) high, including feet and handle ends.

**Case** -- High strength aluminum, painted.

# PART II

## OPERATING INSTRUCTIONS

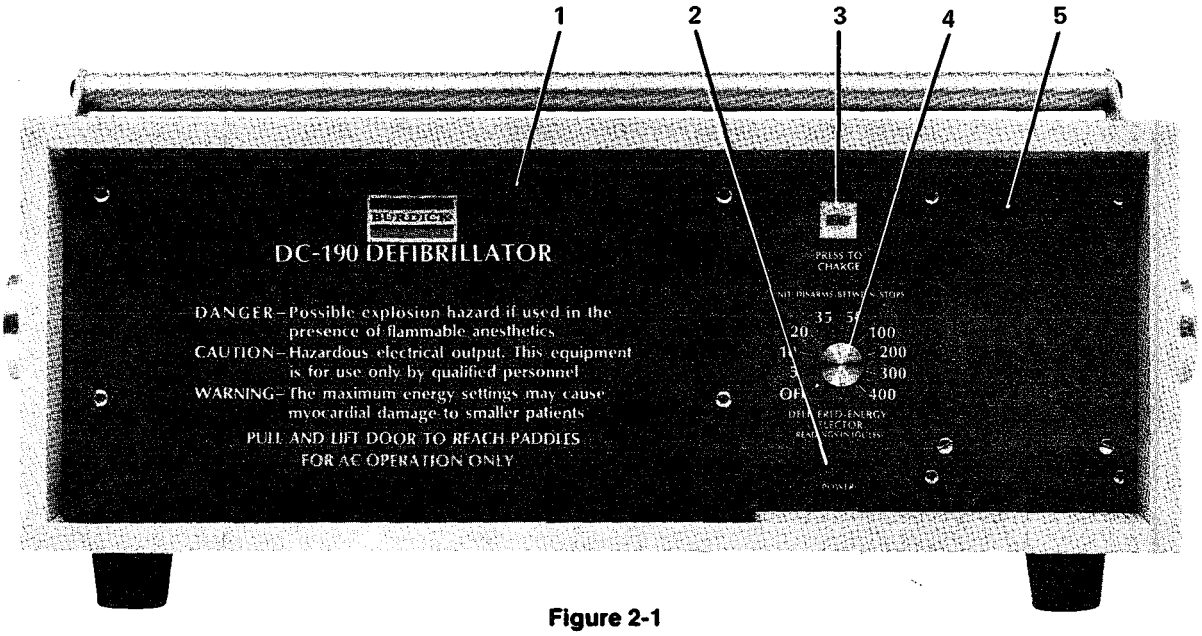



**Figure 2-1**

## Front Panel

**Access Door** (Fig. 2-1-1). External electrodes are stored in the compartment behind this door. To store paddles, position one paddle handle upward and the other downward. Carefully push coiled cables into the storage area. Then, insert both paddles all the way to the back of the storage area. Note: newer type paddles can be inserted with both paddle handles facing up.

The **Paddle Connector** is located in the rear center of the electrode compartment. To remove the plug, unscrew the plug ring and pull the plug straight out. To insert the plug, push plug straight into the connector, with the keyway straight up. Next, screw the plug ring down tightly.

## Central Control Panel

**NOTE: Units with serial numbers above 10,000 will have a maximum energy output of 360 joules.**

**Delivered Energy Selector** (Fig. 2-1-2). This selector knob, which also serves as the POWER ON switch, permits presetting the delivered energy level. When the unit is not in use, the knob should be rotated to the OFF position.

If the selected energy must be altered when the unit is already charged (**Ready**), rotate the selector knob to the desired level and press the **Charge** button again. As a safety feature, any rotation of the selector knob while the unit is charged automatically disarms the unit.

The circuitry will whistle slightly while charging. When fully charged, the button will light up and an audio signal will be heard. Charge time is less than one second for 20 joules, approximately 2½ seconds for 100 joules, and from 7½ to 10 seconds for 400 (360) joules. (One joule = one watt-second).

**Press to Charge Button** (Fig. 2-1-3). When pushed momentarily, this button will initiate the charge cycle and bring the stored energy of the defibrillator up to the level selected by the delivered energy selector.

**Power** (Fig. 2-1-4). The red pilot light will glow whenever the unit selector knob is moved from the OFF position.

**Blank Panel or Synchronizer Module** (Fig. 2-1-5). The blank panel in this section is standard equipment. For cardioversion procedures, an optional Synchronizer/Preamplifier can be utilized in combination with a Burdick cardiac monitor that displays the patient's ECG data. With a synchronizer module, the defibrillator electrodes can be used as active monitoring electrodes. Synchronization is initiated by pressing the SYNC button which inhibits the defibrillator pulse until an R-wave occurs. When the energy has been delivered to the patient, the synchronizer button is automatically deactivated.

Note: Do not discard the blank panel.

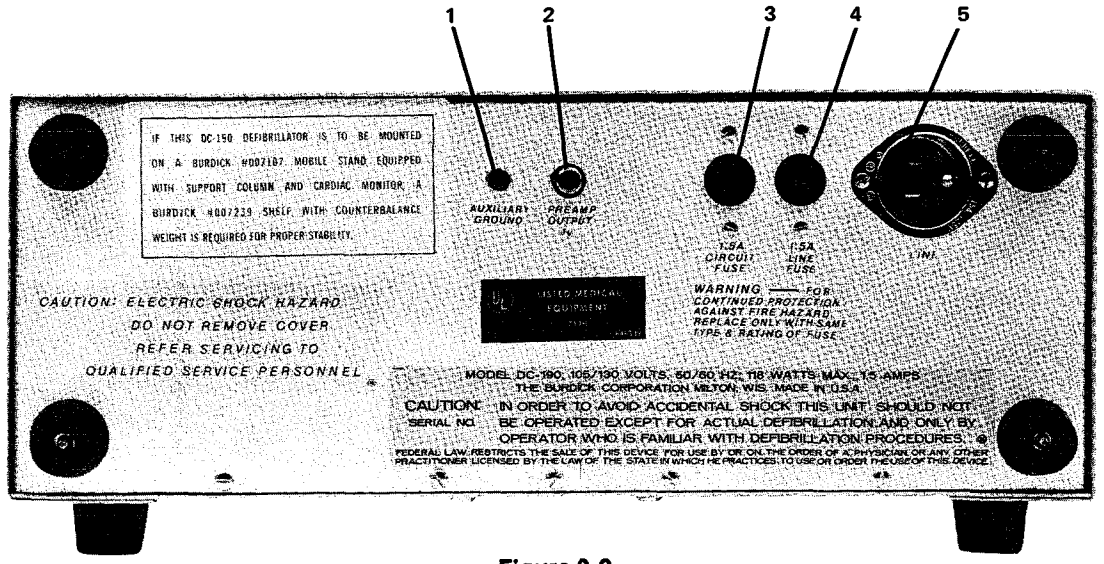



**Figure 2-2**

## Back Panel

**Auxiliary Ground** (Fig. 2-2-1). This jack provides a direct connection to the DC-190 Defibrillator chassis.

**Preamp Output** (Fig. 2-2-2). This phone jack provides a 1 volt output to a Burdick monitor for observing the ECG when the optional synchronizer preamp is used.

**Circuit Fuse** (Fig. 2-2-3). This slow-blow fuse protects the printed circuit boards should an overload occur.

**Line Fuse** (Fig. 2-2-4). This slow-blow fuse protects the line connector and line should an overload occur. NOTE: This is a 2.0A fuse for units above serial number 11,000.

**Line Power Connector** (Fig. 2-2-5). This connector provides for line power input to the DC-190.

## Ground and Power Connection

Connect the power cable to the defibrillator and properly maintained and grounded electrical outlet that corresponds to the voltage and frequency indicated on the rating plate. The unit will be automatically grounded if the power cable and grounding-type electrical outlet are in good repair. If proper grounding is not available through the normal power connection, the ground lead should be connected between the ground jack and a suitably grounded object.

# DC-190 BLOCK DIAGRAM DESCRIPTION (Fig. 2-3)

## Line Converter Block (Fig. 2-3)

The Line Converter is active any time the unit is plugged into the line. It constantly provides power to the circuitry when the LEVEL CONTROL is turned from the OFF position. By means of an internal jumper on the Line Converter board, the unit can be modified to operate on 210 VAC.

The 12 VDC output (+F) is applied to the rest of the circuitry through the contacts of switch S-1C.

## Energy Selector Switch Block (Fig. 2-3)

Energy Selector Switch S-1 is a three-level wafer switch. Contacts S-1A select the energy level to be delivered at the paddles. Contacts S-1B provide +FRS voltage (+A, fused, regulated and switched) to the Charge Logic block. This voltage is interrupted whenever the position of switch S-1 is changed and results in disarming the defibrillator. The charge sequence must be restarted after any change in the position of S-1. Contacts S-1C provide +F DC voltage (A+, Fused) throughout the unit.

A fourth wafer will be present on newer units. This wafer (S-1D) inhibits defibrillator charging if the switch is set beyond 50 joules and serialized internal paddles are used.

## The Charge Block (Fig. 2-3)

The charge block contains the Charge Switch S-2 and READY indicator light. Pressing the charge switch initiates the charging sequence provided that switch S-1 has been rotated from the OFF position. On completion of the charge sequence a READY ENABLE is generated in the charge logic block which lights the READY LIGHT indicator and turns on the audible BEEPER indicator.

## Charge Logic Block (Fig. 2-3)

The charge logic circuitry acts as the central processor for signals received from the rest of the circuitry. The CHARGE SIGNAL from the charge button to the charge logic initiates a CHARGE ENABLE to the high Voltage Converter. This same input causes the charge logic to energize the disarm relay allowing the storage capacitor to charge, inhibits the High Voltage Converter Run-On Fault logic and inhibits the defibrillator logic until the joule logic circuit indicates that the storage capacitor has charged to the selected level.

The input from the joule logic block causes the charge logic to turn on the READY indicator lamp, the audible BEEPER signal, removes the inhibits from the defibrillator logic and the High Voltage Converter Run-On Fault logic and turns off the high voltage converter charge circuitry by removing the CHARGE ENABLE.

After defibrillation, a reset pulse from the defibrillator logic block to the charge logic resets the charge logic removing the disarm inhibit. Disarm relay K-100 de-energizes and connects dump load resistor R-110 across storage capacitor C-300.

## High Voltage Converter Block (Fig. 2-3)

The high voltage converter contains the charging circuitry for the storage capacitor and disarm relay K-100. The circuitry is energized by the S1-C contacts of the ENERGY SELECTOR SWITCH. When the CHARGE BUTTON is pressed, an enable from the charge logic circuit initiates the charging process while the DISARM INHIBIT from the charge logic circuit holds disarm relay K-100 energized. The circuit also provides charge level information to the joule logic circuit.

## Joule Logic Block (Fig. 2-3)

The joule logic circuit senses the charge level on storage capacitor C-300. When the stored

charge reaches the selected level, the joule logic generates a signal to the charge logic block which enables the READY light and audible BEEPER. The same signal removes the charge enable from the high voltage converter charging circuitry, removes the High Voltage Run-On Fault logic inhibit and the inhibit to the defibrillator logic.

## High Voltage Run-On Fault Dump Logic (Fig. 2-3)

Should the high voltage converter continue to charge the storage capacitor after the charge enable is removed this circuit will generate a reset to the charge logic circuitry. This reset removes the disarm inhibit and causes K-100 to de-energize connecting C-300 to the dump load resistor R-110. This action prevents an incorrect energy level being delivered. The circuit is inhibited during normal charge time by IC-2 Pin 10.

## Loss of Level Control Fault Dump Logic (Fig. 2-3)

Should a fault occur in the DC-190 that causes storage capacitor C-300 to charge to approximately 6600 volts this circuit will generate a reset to the charge logic circuitry. This reset removes the disarm inhibit and causes K-100 to de-energize connecting C-300 to the dump load resistor R-110. This action will protect circuit components from damage due to overvoltage and prevent an excessive energy level being delivered.

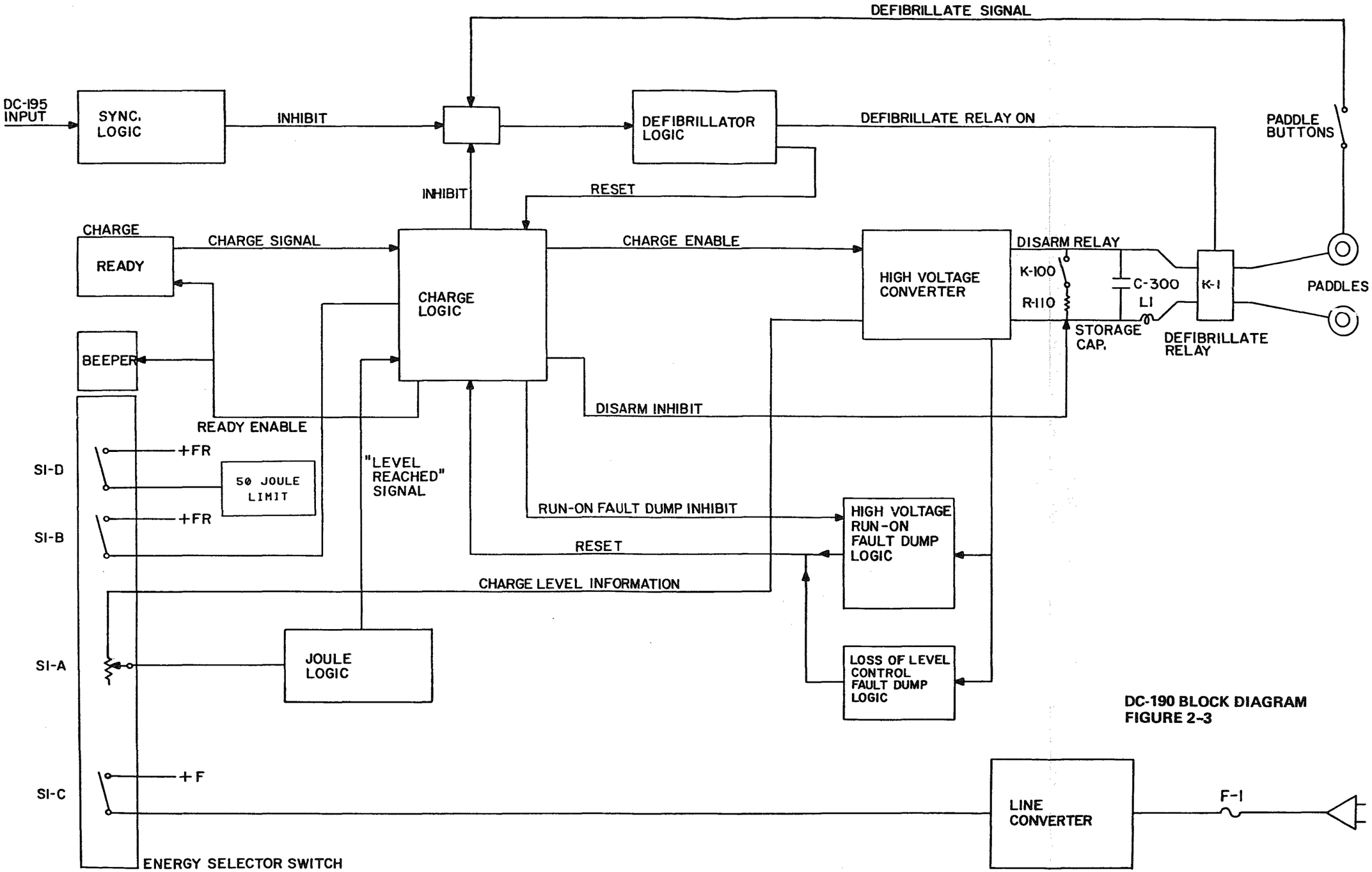
## Sync Logic Block (Fig. 2-3)

The sync logic circuitry is controlled by a switch on the optional DC-195 SYNCHRONIZER. If the SYNC function is selected the circuit will inhibit the defibrillator logic until an R wave is received from the DC-195 circuitry. This feature prevents defibrillation until a special period during a heartbeat occurs.

## 50 Joule Limit

**(units above serial no. 10,000)**

This block prevents charging above 50 joules if serialized internal paddles are used. The unit senses the internal paddles and inhibits charging if the ENERGY SELECT switch is set above 50 joules.




**DC-190 BLOCK DIAGRAM**
**FIGURE 2-3**

# PART III

## DETAILED THEORY OF OPERATION

### Turn On (Fig. 4-1)

Rotating Energy Selector Switch S-1 from OFF to any selected joule level applies power from the Line Converter to the defibrillator circuitry through the contacts of switch S-1C. Power is applied to filter capacitor C-102 located on the High Voltage Converter board. From C-102 power is applied to all low power circuitry through circuit fuse F-2. The high power circuitry located on the High Voltage Converter board is protected by line fuse F-1.

### Charge Sequence (Fig. 3-1 & 4-1)

The charge sequence is initiated by pushing CHARGE switch S-2. Pushing S-2 applies a positive 12V square wave to the Charge Logic circuit via J-3.18. This square wave is differentiated by C-1, R-1, and R-2. This results in a positive pulse being applied to pin 12 of flip-flop IC-1. IC-1 flips and output pin 10 goes positive. This positive is applied to Q-1 and IC-2 pins 14 and 15.

The positive on the base of transistor Q-1 turns Q-1 on and energizes DISARM relay K-100 allowing storage capacitor C-300 to charge.

The positive on pin 14 of IC-2 applies power to IC-2. At the same time a pulse from the differentiator composed of C-3 and R-10 is fed to IC-2 pin 5. This causes IC-2 to flip and output pin 10 to go positive. This positive is applied to transistors Q-2 and Q-6.

The positive fed to the base of Q-6 turns it on thus inhibiting the High Voltage Converter Run-On Fault Dump Logic during normal charge time.

At the same time that IC-2 pin 10 went positive, pin 4 of IC-2 went to "0" forward biasing diode CR-4. This "0" is felt in the Defibrillator Logic and inhibits the circuit during normal charge time.

The positive on the base of Q-2 turns Q-2 on, enabling the charge circuitry on the High Voltage Converter board by shorting J-2.8 to ground. This turns transistor Q-100 on, applying power to transistor Q-101 and oscillator IC-100.

Q-101 completes the base drive circuit for flyback oscillator transistors Q-102 and Q-103. The collectors of Q-102 and Q-103 drive the primary of high voltage transformer T-2. Feedback is fed to the bases of Q-102 and Q-103 via CR-101, drive adjust potentiometer R-106 and R-107 and R-108. R-106 is used to adjust charge time to 400 (360) joules. The charge time should be 7.5 to 10 seconds.

**CAUTION:** SHOULD THIS ADJUSTMENT BE REQUIRED, BEWARE OF HIGH VOLTAGE.

The positive pulses on the primary of transformer T-2 may reach a level of 85 volts. This voltage is stepped up to a maximum of about 5700 volts on the secondary if energy selector switch S-1 is set to 400 (360) joules. The voltage on the secondary is rectified by high voltage rectifier CR-102 and applied to storage capacitor C-300, causing the voltage to build gradually to the selected level. A setting of 5 joules will build to approximately 650 volts in less than one second, while a 400 (360) joule level will require 7.5 to 10 seconds to build to approximately 5700 volts.

Oscillator IC-100 is required to start the flyback oscillator because the reflected impe-

dance from T-2 secondary is extremely low until the charge on C-300 builds. Once charging has started, IC-100 has no effect on oscillator action.

## Ready

Due to close coupling across the high voltage transformer, the fly-back pulses on the base and collector coils of Q-102 and Q-103 gradually increase in step with the charge on C-300.

The negative pulses on the base coil are fed back to the joule logic circuitry via J2.2 and the selected resistor of energy select switch S-1A. The negative pulses are applied to the base of transistor Q-5 via J3.19. Transistor Q-5 is normally off due to a positive reference voltage on its base. This reference voltage is set by a zener diode CR-6. When the amplitude of the negative pulses developed across R-16 and R-17 is sufficient to overcome the positive bias transistor Q-5 conducts removing forward bias from transistor Q-4. Collector voltage on Q-4 goes positive. This positive is fed to pin 1 of IC-2 flip-flop causing output pin 11 to go positive. This turns on transistor Q-3 lighting the READY light. The positive on IC-2 pin 11 also enables the beeper circuitry turning on the beeper.

When IC-2 pin 11 goes positive, IC-2 pin 10 goes to 0, turning off transistor Q-2. This removes power from Q-100, Q-101, Q-102, Q-103 and IC-100. This stops charging on C-300. IC-2 pin 10 going to 0 also removes the inhibit to the run-on fault dump logic. Should the high voltage converter charge circuitry continue to run, a reset will be generated to close the contacts of dump relay K-100 to discharge capacitor C-300.

## Defibrillate

Once charged, the defibrillator may be discharged into the patient, a defibrillator power meter, into the air (open paddles), or short circuited (shorted paddles) by pressing both paddle buttons. Although the design allows the short circuit discharge at any joule level, it should be avoided at or above 35 joules to avoid unnecessary stress on circuit components.

Pressing both paddle buttons shorts pins C and F on output connector J-6, placing a short circuit across the secondary of transformer T-3. As the collector voltage of Q-10 decreases, transistor Q-11 turns on and its collector goes positive. This positive voltage is differentiated by C-15 and R-43 and applied to pin 1 of IC-1.

Integrating one-shot multivibrator IC-1 fires resulting in a positive pulse out on pin 4. This pulse turns on Q-12 and Q-13 energizing defibrillate relay K-1 via J3.20 for a short period. The right and left paddles are thus momentarily connected to the storage capacitor. If the paddles are connected to a patient, tester, or short circuited, the stored energy will be delivered. For an open paddles discharge, the energy remains in the storage capacitor for the moment. The positive pulse from IC-1 is also fed to the base of Q-1 via CR-2 to insure that K-100 remains energized until defibrillation is completed.

At the end of the one-shot pulse, Q-12 and Q-13 turn off, de-energizing relay K-1 and reconnecting the paddles to the contacts leading to preamp socket J-4.

When transistor Q-13 turns off, its collector goes positive, generating a reset through differentiator C-17 and R-46. This reset is applied to pin 8 of IC-1 and causes output pin 10 to go to 0 . Transistor Q-1 cuts off de-energizing disarm relay K-100. The contacts of K-100 close, placing resistor R-110 across storage capacitor C-300. Any remaining charge on C-300 will be discharged through R-110. At the same time, another reset was generated through differentiator C-19 and R-48 and applied to the Sync Logic circuit turning it off.

The READY light and BEEPER are turned off when IC-1 pin 10 goes to 0 . Power is removed from IC-2 pin 14 and IC-2 pin 11 goes to 0 turning off Q-3 and removing power from the Beeper Oscillator, IC-4.

## Line Converter (Fig. 4-3)

### Rectifier Section

For 120 VAC operation, two of the diodes in bridge rectifier CR-200 and capacitors C-201 and C-202 form a full wave voltage doubler.

For 220 VAC operation, the circuit is configured as a full wave bridge with a capacitive filter composed of C-201 and C-202.

### Oscillator Section

Voltage across C-201 and C-202 causes capacitor C-203 to charge through R-203. At approximately 30 volts, diac CR-201 conducts, providing bias to the base circuit of Q-201. The circuit composed of T-201 and matched transistors Q-201 and Q-200 will oscillate, with oscillations maintained by feedback through transformer T-201. The output of this circuit is a nominal 350 VPP across the primary of T-200. T-200 is a step-down transformer, with the output across the full secondary being 48 volts.

Great care must be taken if measurements are made on these circuits while operating the unit. High DC and AC voltages are present here whenever the unit is plugged in.

### Output Section

The output at terminal LC-E is 12 volts DC rectified by CR-202 and filtered by an L-C filter composed of L-201 and capacitor C-102 on the high voltage converter board.

## Line Converter (above serial no. 11,000) (Fig. 4-1B)

Power is derived directly from the AC line. VR102 provides surge current limiting. D107 and associated components serve as a rectifier and voltage doubler. VR101 protects the power supply if the wrong AC line voltage is applied. Power for the control regulator circuitry is derived through transformer T101 and rectified by D103. IC101 provides a regulated +12V. Fuse F101 protects against short circuit conditions.

During the power up, C103 becomes fully charged through D102, allowing Q101 to turn on. While C104 charges through R102, Q102 passes approximately +12V to pin 1 of IC102, a pulse width modulator control regulator. Thus, the regulator is disabled until C104 is charged and Q101 stops conducting. At this point, the power up is complete and normal operation can begin. IC102 is also disabled during a power down when D101 discharges C104, allowing Q102 to conduct.

The control regulator (IC102) and associated resistors and capacitors consist of two error amplifiers which sense output voltage and current. The sense signals are compared to an internal reference. As a result, an error signal is produced which modifies the pulse width of the output until the error signal is zeroed.

Both signals from IC102 are applied to identical power buffers. Q103 and Q104 are in the push/pull configuration and are alternately switched by IC102. R115 and R113 assure proper biasing, which D121 and D122 protect against reverse bias conditions. D105 ensures that Q103 and Q104 will not conduct simultaneously. C117 couples the 40kHz signal to T103, while blocking any DC current flow.

Q107 and Q108, arranged in the push/pull configuration, are power switches. They are driven through T103 and T104. Diodes D110-D115 provide fast switching times for Q107 and Q108. C114 blocks any 60Hz ripple from the power converter transformer, T102, but allows the 40KHz switching signals to pass. D116 rectifies the output from the secondary of T102 and filtering is provided by L101, C119, R128, and C118.

## PROTECTION CIRCUITS

Energy selector switch contacts S-1B interrupt power to IC-1 whenever the energy level is changed. This results in IC-1 Pin 10 going to 0 . This 0 level turns off transistor Q-1 de-energizing K-100 and causing any charge on capacitor C-300 to be dumped. This protects the patient by preventing an incorrect energy level being delivered. The charge sequence must be re-started by pressing the Charge switch.

The joule logic circuit provides an accurate energy level regardless of varying line and battery voltages.

The High Voltage Converter Run-On Fault Dump Logic disarms the defibrillator should a fault cause the High Voltage Converter to continue charging C-300 after the selected energy level is reached. During normal charge time, the Run-On fault logic is inhibited by the positive voltage on pin 10 of IC-2. This positive is fed to the base of transistor Q-6 holding it on. Any signals from the High Voltage Converter through R-20 and C-6 are thus shorted to ground through the low impedance of Q-6. At the end of normal charge time the joule logic circuit generates a signal which causes IC-2 pin 10 to go to 0 . This turns off transistor Q-6. If the High Voltage Converter continues to oscillate pulses from the collector, circuits of Q-102 and Q-103 will be fed to diode CR-8 via J2.4, R-20 and C-6. This generates a reset to IC-1 causing pin 10 to go to 0 . Transistor Q-1 cuts off, de-energizing K-100, disarming the defibrillator.

The loss of Level Control Fault dump logic will disarm the defibrillator should a problem in the energy selector switch or joule logic circuit allow C-300 to charge to approximately 6600 volts. Pulses from the collector circuits of Q-102 and Q-103 are fed to the loss of level control logic via J-2.4, CR-10 and R-22. Due to close coupling across the high voltage transformer T-2 the voltage on the collectors of Q-102 and Q-103 increases in step with the charge on C-300. When this voltage reaches an amplitude corresponding to a charge of 6600 volts, zener diode CR-11 will conduct turning on Q-7. The conduction of Q-7 generates a reset to IC-1. Pin 10 of IC-1 goes to 0 turning off Q-1. Relay K-100 de-energizes disarming the defibrillator.

## DC-190 Sync Logic Circuitry (Fig. 4-1)

The defibrillator, when equipped with the optional DC-195 isolated preamp and synchronizer, can be used to convert a heart rhythm to a more desirable type by "defibrillating" the patient in a controlled manner. This is called conversion.

The DC-195 contains a preamplifier and synchronizer for this procedure. Pressing the SYNC ON/OFF switch allows the defibrillator paddles to be used as monitoring electrodes. The action of the defibrillator is inhibited until an R-wave occurs. If an R wave is detected while both paddle switches are depressed, the energy will be delivered and the synchronizer will be deactivated automatically.

Pushing the SYNC ON/OFF switch on the DC-195 connects +F to pin E (5) of J-4. This voltage is fed to pin 8 of IC-3 via J-3.7. IC-3 is a dual flip-flop hooked up as a pulse stretching switch bounce eliminator. Pin 1 of IC-3 goes positive turning on Q-14 and Q-17. Q-17 turning on provides a ground path to the DC-195 to light the sync lamp. Q-14 turning on inhibits the defibrillator logic by placing a low impedance to ground at C-14 thus shorting out any defibrillate signal from Q-11. The DC-195 produces a positive pulse to pin H (8) of J-4 for every R wave that occurs. This positive pulse is coupled through C-22, and CR-20 to the base of transistor Q-15 turning it on momentarily. When Q-15 turns on, Q-14 turns off removing the inhibit from the defibrillator logic. If both paddle switches are being held down, transistor Q-11 is conducting. Removing the sync logic inhibit from the defibrillator logic allows the collector voltage of Q-11 to be differentiated by C-15 and R-43 firing the one-shot multivibrator, IC-1, to complete the defibrillate sequence.

At the end of the defibrillate sequence, a reset pulse from Q-13 to pin 4 of IC-3 causes pin 1 to go low turning off transistor Q-17. This removes the ground from the DC-195 sync lamp and turns it off. If additional synchronized conversions are required, it is necessary to press the sync switch each time synchronization is desired.

## Interface Panel

A positive or negative square wave of about 10 volts amplitude is required to trigger the sync circuit when an interface panel is used instead of the sync preamp. If positive, the signal proceeds from pin J(8) of J-4 thru C-22 and CR-20 to Q-15. If negative, thru Q-16, C-21 and CR-19 to Q-15.

## Charge Inhibit Logic PC Board

Circuits on this board provide a 50 joule energy limit and a DC power regulator reference voltage.

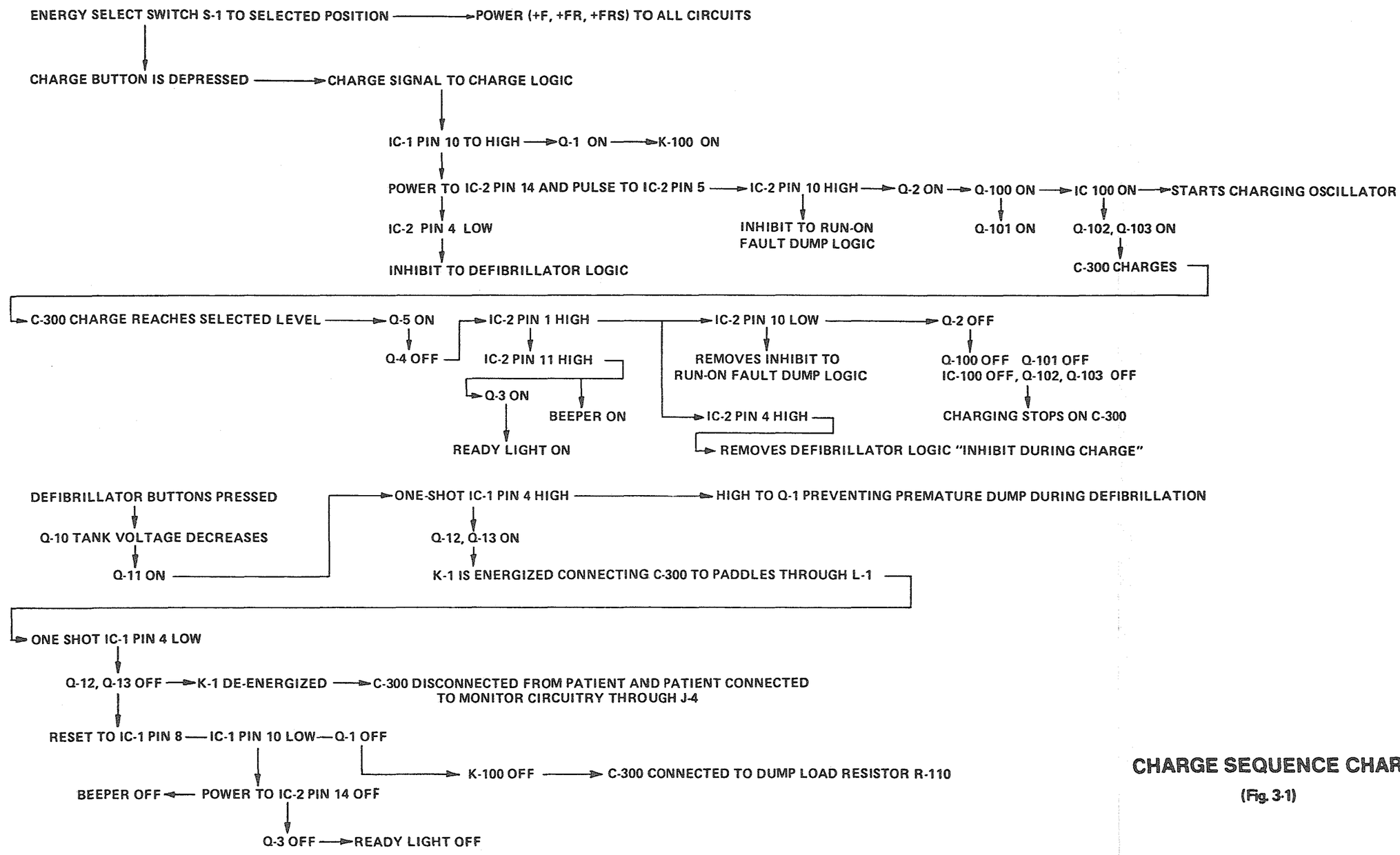
## 50 Joule Energy Limit

If internal paddles are being used, pins B and E of output connector J-6 will be connected by a 20K resistor located in the paddles.

When switch S1 is set beyond 50 joules, contact S1-D opens turing Q-403 in the joule limit circuitry off.

The 20K resistor connecting pins B and E of J-6 causes the output of IC-401 pin 14 to go LO. This causes IC-401 pin 8 and pin 1 to go LO. IC-401 pin 7 will go LO turning off Q-402.

Transistor Q-401 turns ON preventing the charge latch from setting and shunting the charge to ground.


ENERGY SELECT SWITCH S-1 TO SELECTED POSITION
POWER (+F, +FR, +FRS) TO ALL CIRCUITS
CHARGE BUTTON IS DEPRESSED
CHARGE SIGNAL TO CHARGE LOGIC
IC-1 PIN 10 TO HIGH
Q-1 ON
K-100 ON
POWER TO IC-2 PIN 14 AND PULSE TO IC-2 PIN 5
IC-2 PIN 10 HIGH
Q-2 ON
Q-100 ON
IC 100 ON
STARTS CHARGING OSCILLATOR
IC-2 PIN 4 LOW
INHIBIT TO RUN-ON FAULT DUMP LOGIC
Q-101 ON
Q-102, Q-103 ON
INHIBIT TO DEFIBRILLATOR LOGIC
C-300 CHARGES
C-300 CHARGE REACHES SELECTED LEVEL
Q-5 ON
IC-2 PIN 1 HIGH
IC-2 PIN 10 LOW
Q-2 OFF
Q-4 OFF
IC-2 PIN 11 HIGH
REMOVES INHIBIT TO RUN-ON FAULT DUMP LOGIC
Q-100 OFF Q-101 OFF
IC-100 OFF, Q-102, Q-103 OFF
Q-3 ON
BEEPER ON
CHARGING STOPS ON C-300
IC-2 PIN 4 HIGH
READY LIGHT ON
REMOVES DEFIBRILLATOR LOGIC "INHIBIT DURING CHARGE"
DEFIBRILLATOR BUTTONS PRESSED
ONE-SHOT IC-1 PIN 4 HIGH
HIGH TO Q-1 PREVENTING PREMATURE DUMP DURING DEFIBRILLATION
Q-10 TANK VOLTAGE DECREASES
Q-12, Q-13 ON
Q-11 ON
K-1 IS ENERGIZED CONNECTING C-300 TO PADDLES THROUGH L-1
ONE SHOT IC-1 PIN 4 LOW
Q-12, Q-13 OFF
K-1 DE-ENERGIZED
C-300 DISCONNECTED FROM PATIENT AND PATIENT CONNECTED TO MONITOR CIRCUITRY THROUGH J-4
RESET TO IC-1 PIN 8
IC-1 PIN 10 LOW
Q-1 OFF
K-100 OFF
C-300 CONNECTED TO DUMP LOAD RESISTOR R-110
BEEPER OFF
POWER TO IC-2 PIN 14 OFF
Q-3 OFF
READY LIGHT OFF

## CHARGE SEQUENCE CHART

(Fig. 3-1)

# PART IV

## SERVICE CAUTIONS

Exercise extreme caution when working inside the DC-190. Voltages as high as 5700 volts may be encountered. Always insure that capacitor C-300 is fully discharged. Also use care in making measurements on the Line Converter as it is connected directly to the powerline and is operational as long as the DC-190 is plugged in.

## REMOVAL AND REPLACEMENT PROCEDURES

### To Remove Wrap-Around Assembly

1. Stand the unit on its rear panel feet.
2. Remove the four pan-head screws located on the edges of the bottom panel.
3. Lift the wrap-around assembly straight up and clear of the unit.

### Fuse Replacement

1. With a wide blade screwdriver, turn the slotted portion of the fuse holder counterclockwise until free.
2. Fuses should be replaced with spares of the proper rating. Do not exceed the the fuse rating on the rear panel.

**Caution**: THE DC-190 IS AC OPERATED ONLY. PRIOR TO PERFORMING ANY OF THE FOLLOWING PROCEDURES, REMOVE THE LINE CORD.

### Removal of Capacitor C-300

1. Remove the wrap-around assembly.
2. Remove the fish paper insulator.
3. INSURE THAT CAPACITOR C-300 IS DISCHARGED.
4. Remove the terminal nuts and then mark and remove the wires.
5. Remove the capacitor clamp screws and the capacitor clamps.
6. Lift C-300 up and out.
7. Reverse the above to replace.

### Removal of Defibrillator Relay K-1

1. Remove the wrap-around assembly.
2. Remove the fish paper insulator.
3. INSURE THAT CAPACITOR C-300 IS DISCHARGED.
4. Mark and remove the leads.
5. Remove the four screws holding the base of K-1 to the bottom pan.
6. Lift K-1 up and out.
7. Reverse to replace.

### Removal of Inductor L-1

1. Remove the wrap-around assembly.
2. Remove the fish paper insulator.
3. INSURE THAT CAPACITOR C-300 IS DISCHARGED.
4. Remove the lead from C-300.
5. Remove the lead from K-1.
6. L-1 is mounted with a bolt running through its center with a nut and lockwasher located on the opposite side of the bottom pan. Remove the mounting bolt.
7. Reverse the above to replace.

### Removal of Line Converter P.C. Board

1. Remove the wrap-around.
2. Remove the fish paper insulator.
3. INSURE THAT CAPACITOR C-300 IS DISCHARGED.
4. Remove the three screws on the mounting bracket.
5. Slide the board out.
6. Mark and remove the leads.
7. Reverse the above to replace.

## Removal of High Voltage Converter P.C. Board

1. Remove the wrap-around assembly.
2. Remove the fish paper insulator.
3. INSURE THAT CAPACITOR C-300 IS DISCHARGED.
4. Remove the line converter board.
5. Disconnect the white 8-wire connector.
6. Mark and remove the leads from C-300.
7. On the opposite side of the bottom pan, remove the three mounting bracket screws and the two smaller transformer mounting bracket screws.
8. Slide the board out.
9. Reverse to replace.

## Removal of Logic P.C. Board

1. Remove the wrap-around assembly.
2. Loosen the retaining clamp screws.
3. Rock the board and pull gently to remove.
4. Reverse to replace.

## Removal of Energy Selector Switch

1. Remove the wrap-around assembly.
2. Remove the knob by loosening the two set screws.
3. Remove the shaft nut.
4. Push the switch into the chassis to remove.
5. Mark and remove the leads.
6. Reverse to replace.

## Removal of Charge Switch

1. Remove the wrap-around assembly.
2. Mark and remove the leads.
3. Press the metal retaining spring and push the switch out through the front panel.
4. Reverse to replace.

## Indicator Lamp Assembly Replacement

1. Remove the wrap-around assembly.
2. Remove the logic P.C. board.
3. Remove the aluminum divider to the divider to the DC-195 compartment. On those units with a DC-195 remove the 4-corner screws and push the module out through the front panel.
4. Unsolder the leads.
5. Remove the outside black plastic retaining nut.
6. Pull the light assembly back into the chassis and out.
7. Reverse to replace.

## Removal of Charge Inhibit P.C. Board

(Same as Logic P.C. Board)

# MAINTENANCE PROCEDURES

## EQUIPMENT CHECKOUT

### Charge-Dump-Discharge Sequence

Rotate the energy selector switch to 35 and press the charge button. Unit should charge and the ready light and BEEPER should come on. Rotate the energy selector switch to 50. The ready light and BEEPER should go off as the charge is automatically dumped.

Connect the defibrillator paddles. Press the charge button and allow the unit to charge. Hold the paddles well away from the body and press the paddle buttons one at a time. The unit should not fire. Press the buttons simultaneously and the unit should fire.

Rotate the energy selector switch to 400 (360) joules. Time the period from pressing the charge switch until the ready signal is heard. The time taken should be 7.5 to 10 seconds.

## ADJUSTMENTS

### Joule Level Adjustment (R-17)

**Test Equipment Required:**
**Joule Meter (Neurodyne-Dempsey Model #429 or equivalent).**

PROCEDURE:

1. Resistor R-17 is located on the logic P.C. board toward the front of the unit.
2. Charge the DC-190 to 300 joules and test fire into the joule meter. It should read 300 joules ±4%. If not, adjust R-17 for the proper reading. All levels are adjusted simultaneously.
3. Test fire the defibrillator into the joule meter at all positions of the energy selector switch. The delivered energy should be within a ±4% tolerance at all levels.

### Charge Time (Drive) Adjustment

**Test Equipment Required:**
**Stop watch.**

PROCEDURE:

1. Rotate the energy selector switch to 400 (360) joules. Time the period from pressin the charge switch until the ready indicator comes on. This period should be 7.5 to 10 seconds.
2. If not, it is necessary to adjust R-106.

**CAUTION:** DO NOT ATTEMPT THIS ADJUSTMENT WITH THE DC-190 ON. 5700 VOLTS IS PRESENT ON THE RELAY TERMINALS WHEN C-300 IS CHARGED TO 400 (360) JOULES.

3. Rotate the energy selector switch to OFF. Insure that disarm relay K-100 contacts are closed. Insure that C-300 is discharged.

4. Turning R-106 clockwise decreases the charge time. Turning R-106 counterclockwise increases the charge time. One-third to one-half turn equals one second of charge time.
5. Adjust R-106 and check the charge time to 400 (360) joules. If further adjustment is necessary, be sure to observe the caution.

## Paddle Service (round type)

To remove the electrode discs, apply pressure with the palm of the hand and twist counterclockwise. Discs should be cleaned with ordinary cleanser. DO NOT USE STEEL WOOL.

### Disassembly

1. Remove the electrode disc by twisting counterclockwise six turns.
2. Remove the actuator by prying off the rubber boot.
3. Remove the knurled nut.
4. Remove the Phillips screw in the rear of the handle.
5. Observe the bottom of the paddle assembly. Remove the paddle side without the visible red wire (the right side).
6. Observe the wiring and switch position before proceeding.
7. When replacing the switch, insure that the switch adjustment nut is in the same position as the switch adjustment nut on the previous switch.

### Reassembly

1. Replace the switch. Route the switch wiring in the channel. Insure that the wires are not lying outside the channel.
2. Place the handle sides together. The two sides will mate smoothly with no gap if no wires are being pinched.
3. Replace the electrode disc.
4. Replace the knurled nut.
5. Replace the handle screw.
6. Visually inspect the assembly. A gap at the paddle seams indicates a pinched wire.
7. Put the actuator in place and try the switch several times. It should not bind.
8. Replace the rubber boot.

### Check Out Procedure

1. Press both switches several times to check free operation.
2. Attach the paddles to the defibrillator. Charge the defibrillator to 5 joules.
3. Place the paddles face to face (shorted paddle discharge).
4. Press only the right paddle switch. The defibrillator should not fire.
5. Press only the left paddle switch. The defibrillator should not fire.
6. Press both paddle switches together. The defibrillator should fire.
7. Repeat procedure.

# TROUBLESHOOTING

**Test Equipment Required:**
**Oscilloscope.**
**Joule Meter (Neurodyne-Dempsey Model 429 or equivalent).**
**Digital DC Voltmeter (Fluke 8000A or equivalent).**

## Equipment Setup

Remove the wrap around assembly. Remove the fish paper insulator. If access to the logic P.C. board is required, remove the shield assembly. If a dummy load or defibrillator energy meter is available, it should be utilized to discharge the unit. Shorted paddle discharge is discouraged at energy levels over 35 joules to avoid burns on electrode discs and unnecessary stress on circuit components.

**CAUTION:** EXERCISE EXTREME CARE WHEN WORKING ON OR AROUND THE LINE CONVERTER, HIGH VOLTAGE CONVERTER, K-1, K-100 AND C-300. VOLTAGES HAZARDOUS TO LIFE MAY BE FOUND ON THESE COMPONENTS DURING NORMAL OPERATION.

The troubleshooting procedures presented are intended to assist the technician in locating the trouble area. Additional information is presented in the detailed theory of operation section III. No waveforms are included because the logic circuits are either on or off (low or high), and the oscillator frequencies are not critical.

# Troubleshooting

| Action | Indication |
|---|---|
| Plug the unit into the AC line. Rotate the energy selector switch to 400 (360) joules. | Power on light DS-1 should be on. If not, see procedure 4-1. |
| Press Charge switch S-2. | A high pitched charging whine is heard and a ready signal is generated in about 11 seconds. If not, match the symptoms with the indications given below and see the indicated procedure. |
| | The charging whine is absent entirely. See procedure 4-2. |
| | The charging whine is lower in volume than normal. See procedure 4-3. |
| | No ready signal is generated. A charging whine is heard and K-100 contacts remain open. See procedure 4-4. |
| | A ready signal is generated immediately. See procedure 4-5. |
| | K-100 contacts close and the charge dumps internally at the end of normal charge time. (About 11 seconds at 400 (360) joules). See procedure 4-6. |
| | K-100 contacts close and the charge dumps internally after about 16 seconds. See procedure 4-7. |
| Press the defibrillator paddle buttons. | Unit discharges normally into a joule meter. If not, see procedure 4-8. |

**Procedure 4-1**

For use if power ON light does not come on when the energy select switch is rotated to 400 (360) joules.

1. If the fault is present during AC line operation, check circuit fuse F-1. If the circuit fuse is good, check the indicator lamp.
2. If the fuse blows upon being replaced, there is a short in the +F line. Turn the unit off and measure the resistance to ground from J3.1. If a short circuit exists, disconnect the five lead wires on J3.1 to locate the lead with the short circuit.
3. If the circuit fuse blows when the charge button is pressed, check CR-1 and the regulator as the most likely causes.

**Procedure 4-2**

Pressing the charge switch does not charge the unit and no charging whine is heard. The power indicator is on.

1. Observe the contacts of relay K-100 as the charge switch is depressed. The contacts should open. If not, the problem is the charge logic circuitry, (IC-1, Q-1) or K-100.
2. If K-100 contacts are opening, troubleshoot IC-2, Q-2, and the high voltage converter charging circuitry, (Q-100, IC-100, Q-101, CR-100, CR-101, Q-102, Q-103, and T-2). It is also possible that a short circuit in T-2 secondary is loading the charging oscillator to the point that oscillations cannot occur.

**Procedure 4-3**

The charging whine is lower in volume than normal. No ready signal is generated.

1. These symptoms indicate a short circuit in T-2 secondary. Check the DC resistance of capacitor C-300. It is possible that C-300 will charge normally at lower joule levels but will break down at the higher settings of the energy selector switch.

**Procedure 4-4**

The charging whine is heard and K-100 contacts remain open after 16 seconds. No ready signal is generated.

1. These symptoms indicate a problem in T-2 secondary. The charge on C-300 never reaches the selected joule level. Troubleshoot T-2 and C-300 by substitution.

**Procedure 4-5**

A ready signal is generated immediately after the charge switch is depressed. This symptom indicates an open in transformer T-2 secondary or a problem in joule logic or ready indicator circuitry.

1. To eliminate T-2 secondary circuitry:

   Turn off and unplug the unit. INSURE THAT CAPACITOR C-300 IS DISCHARGED. Utilize an ohmmeter to check CR-102, T-2, R-109, R-110, C-300, K-100 and associated wiring for an open circuit.
2. To eliminate the joule logic circuitry:

   Turn the unit off, then on to reset the logic circuitry. With an oscilloscope, check IC-2, pin 1. It should be low. If not, the trouble is in the joule logic circuitry (Q-5 shorted, Q-4 open). If pin 1 is low, check IC-2, pin 11 for a low. If not, check IC-2 by substitution.

**Procedure 4-6**

The charge on C-300 dumps at the end of normal charge time but prior to the generation of the ready signal. This indicates that a reset is being generated by the High Voltage Converter Run-On Fault Dump Logic.

1. With an oscilloscope, observe pin J3.10. At the end of normal charge time it should go high. If not, the problem is transistor Q-2 or associated circuitry.
2. If pin J3.10 goes high at the end of normal charge time, the problem is either on the High Voltage Converter P.C. board or in the high voltage converter run on Fault Dump Logic.

3. Troubleshoot Q-100, Q-101, Q-102, Q-103 and associated circuitry. Check Q-102 and Q-103 by substitution.

**Procedure 4-7**

The charge on C-300 dumps approximately 16 seconds after the charge button is pressed. No ready signal is generated. A charging whine is heard. This symptom indicates that a reset is being generated by the loss of level control fault dump logic. The fault is either in the energy selector switch, the joule logic, or the charge logic. If the fault is in only 1 position of the energy selector switch, the switch itself contains the problem.

1. With an oscilloscope, observe pin J3.19 during charge time. (1 volt per centimeter, 2 microseconds sweep speed). The signal should be negative going pulses riding at a +2 volt DC level. When the signal reaches 0 volts, a ready signal should be generated. If the signal is present, eliminate the energy selector switch.
2. With an oscilloscope, observe the collector of Q-4. The voltage should momentarily go high at the end of normal charge time. If it does, the problem is in IC-2, if not, troubleshoot the Joule Logic.

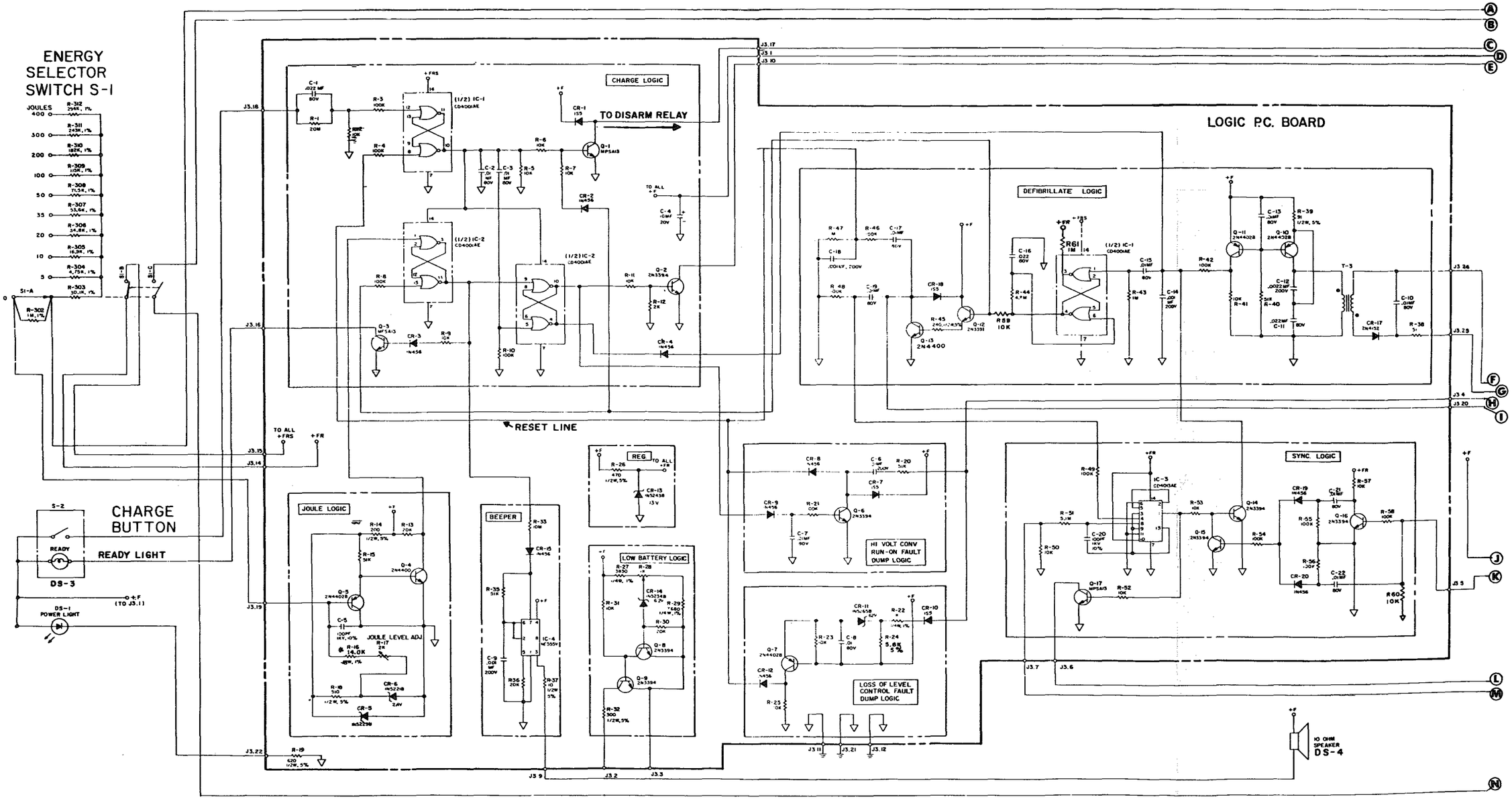
**Procedure 4-8**

The defibrillator will not fire with both paddle buttons depressed.

1. Charge the defibrillator to 5 joules and momentarily short pins J3.24 and J3.25. If the defibrillator fires, the problem is in the paddles. If the defibrillator does not fire, the fault is in the defibrillator logic.
2. Charge the defibrillator to 5 joules and observe the collector of Q-11 while momentarily shorting J3.24 and J3.25. The collector voltage should go high. If not, troubleshoot the oscillator circuitry.
3. Charge the defibrillator to 5 joules, and observe IC-1, pin 4 for a positive pulse while momentarily shorting J3.24 and J3.25. If present, the fault is in K-1 or K-1 control transistors Q-12 and Q-13. If a positive pulse is not present, troubleshoot IC-1 (defibrillator section), and its associated circuitry.

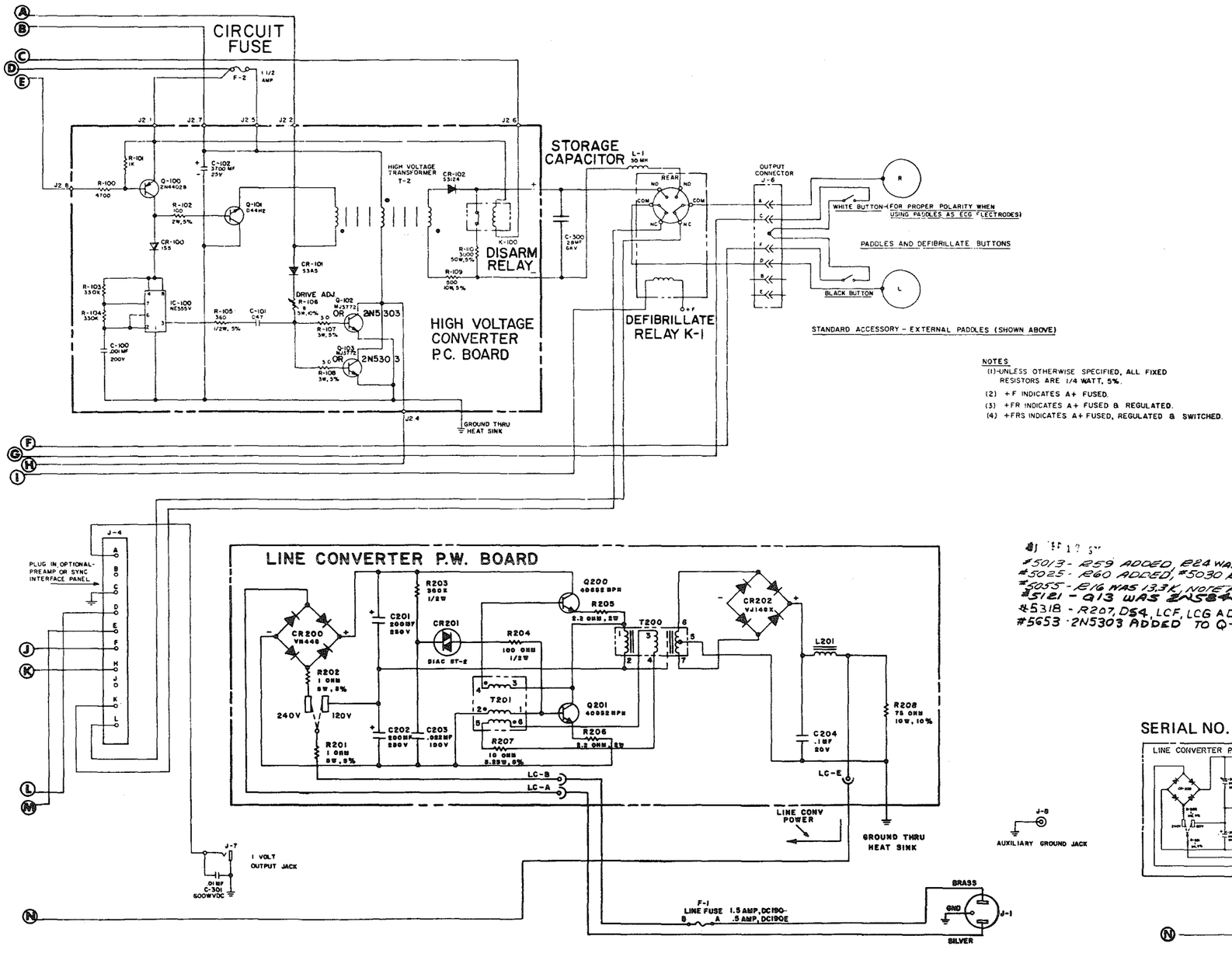
**Notes:**

**DC-190 SCHEMATIC DIAGRAM**
**DRAWING NUMBER 590006**
**FIGURE 4-1**




* FACTORY ADJUSTED TO COMPENSATE FOR STORAGE CAPACATOR (C300) TOLERANCE

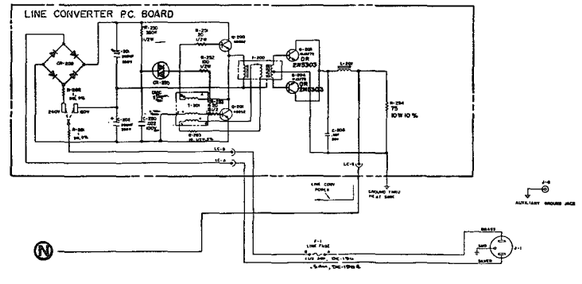
## DC 190 SCHEMATIC DIAGRAM
## DRAWING NUMBER 590006
## FIGURE 4-1


CIRCUIT FUSE
F-2 1 1/2 AMP
HIGH VOLTAGE CONVERTER P.C. BOARD
DISARM RELAY
STORAGE CAPACITOR
DEFIBRILLATE RELAY K-1
OUTPUT CONNECTOR J-6
WHITE BUTTON-FOR PROPER POLARITY WHEN USING PADDLES AS ECG ELECTRODES)
PADDLES AND DEFIBRILLATE BUTTONS
BLACK BUTTON
STANDARD ACCESSORY - EXTERNAL PADDLES (SHOWN ABOVE)
GROUND THRU HEAT SINK
LINE CONVERTER P.W. BOARD
PLUG IN OPTIONAL-PREAMP OR SYNC INTERFACE PANEL
1 VOLT OUTPUT JACK
LINE CONV POWER
GROUND THRU HEAT SINK
AUXILIARY GROUND JACK
F-1 LINE FUSE 1.5 AMP, DC190-.5 AMP, DC190E
BRASS
SILVER

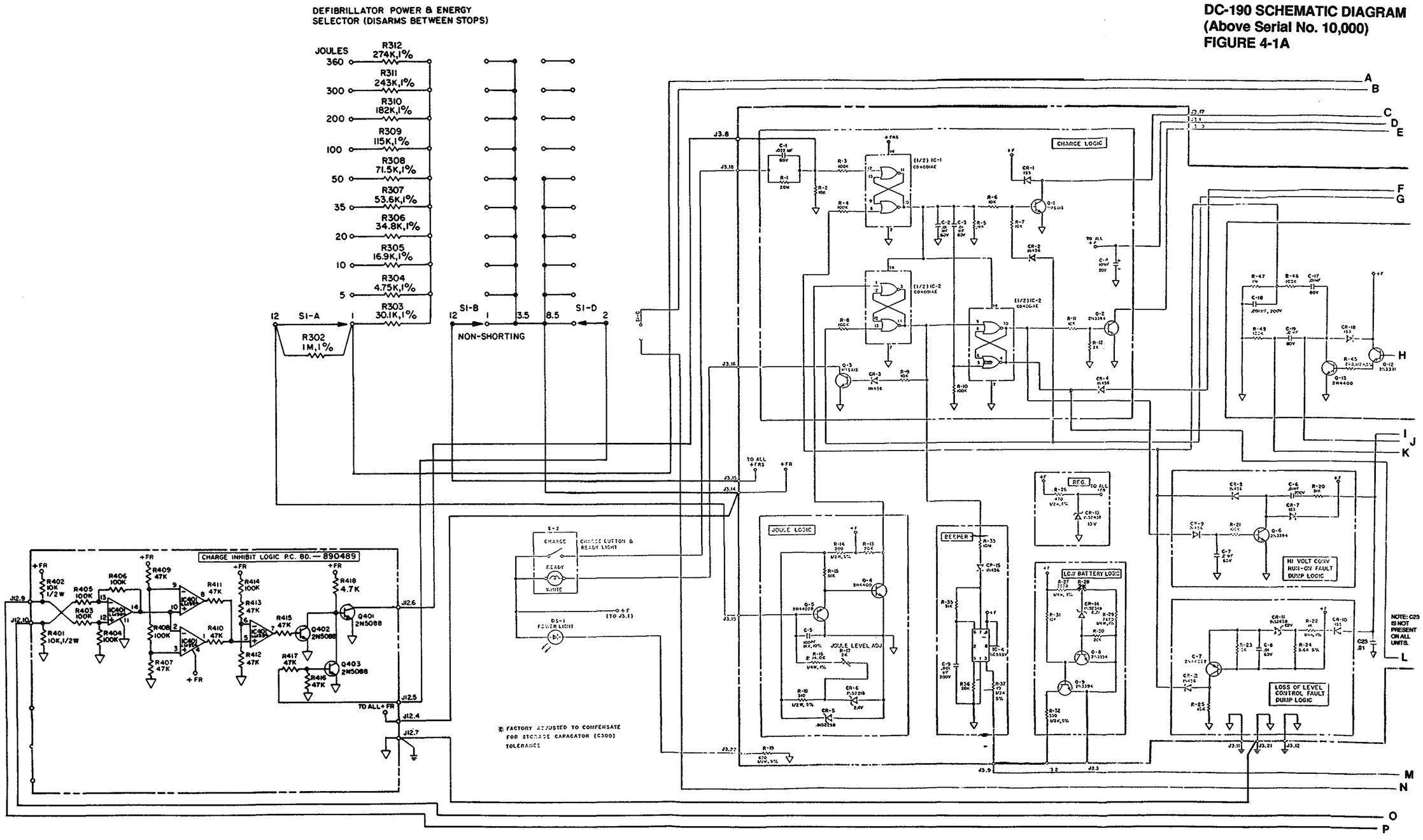
NOTES
(1)-UNLESS OTHERWISE SPECIFIED, ALL FIXED RESISTORS ARE 1/4 WATT, 5%.
(2) +F INDICATES A+ FUSED.
(3) +FR INDICATES A+ FUSED & REGULATED.
(4) +FRS INDICATES A+ FUSED, REGULATED & SWITCHED.

#5013 - R59 ADDED, R24 WAS 3830 1/4W, 1% Q12 WAS 2N3394
#5025 - R60 ADDED, #5030 R61,
#5055 - R16 WAS 13.3K, NOTE ADDED
#5121 - Q13 WAS 2N5845
#5318 - R207, D54, LCF, LCG ADDED
#5653 - 2N5303 ADDED TO Q-102,3, 202,3

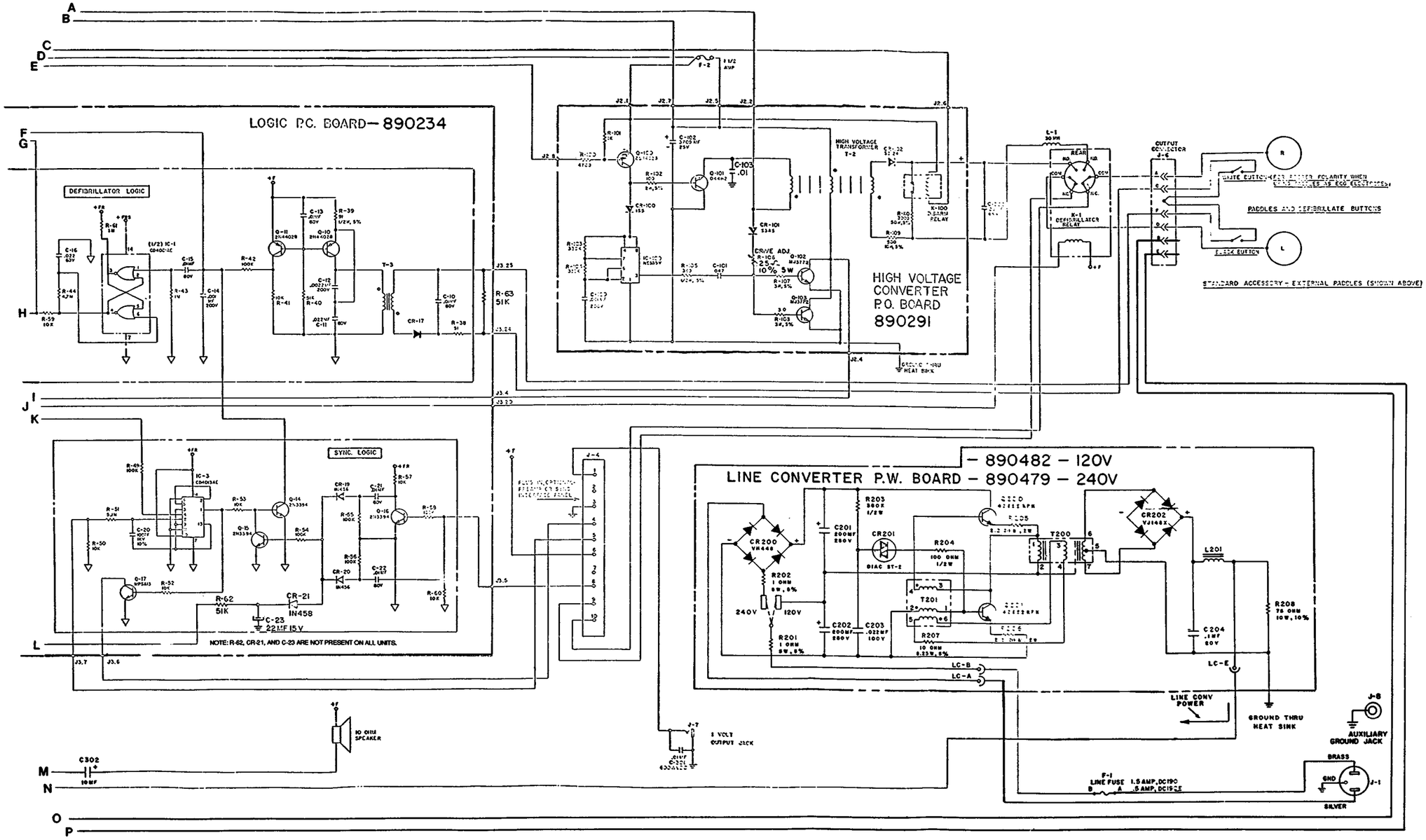
SERIAL NO. 8001 thru 8641



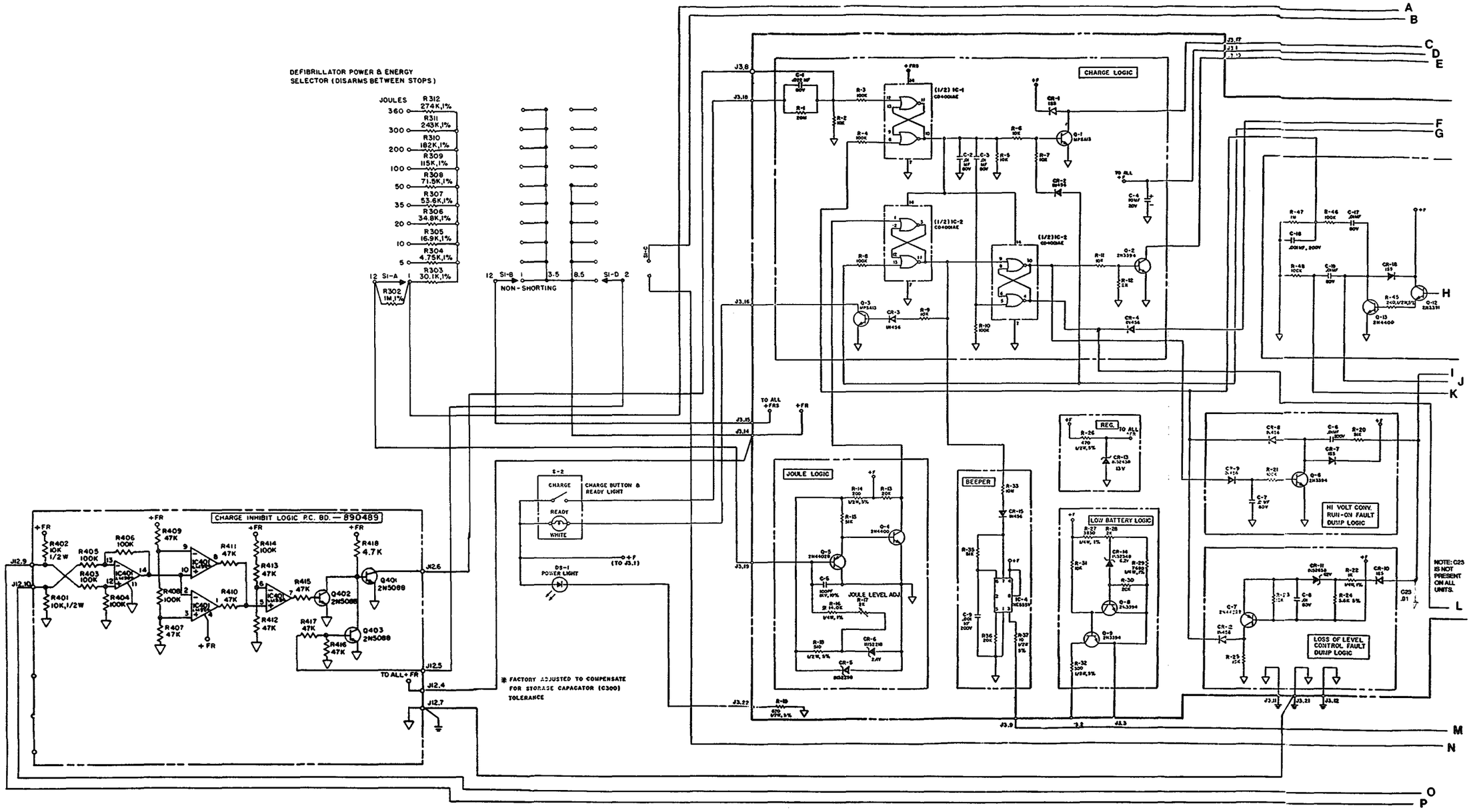
# DC-190 SCHEMATIC DIAGRAM
# (Above Serial No. 10,000)
# FIGURE 4-1A



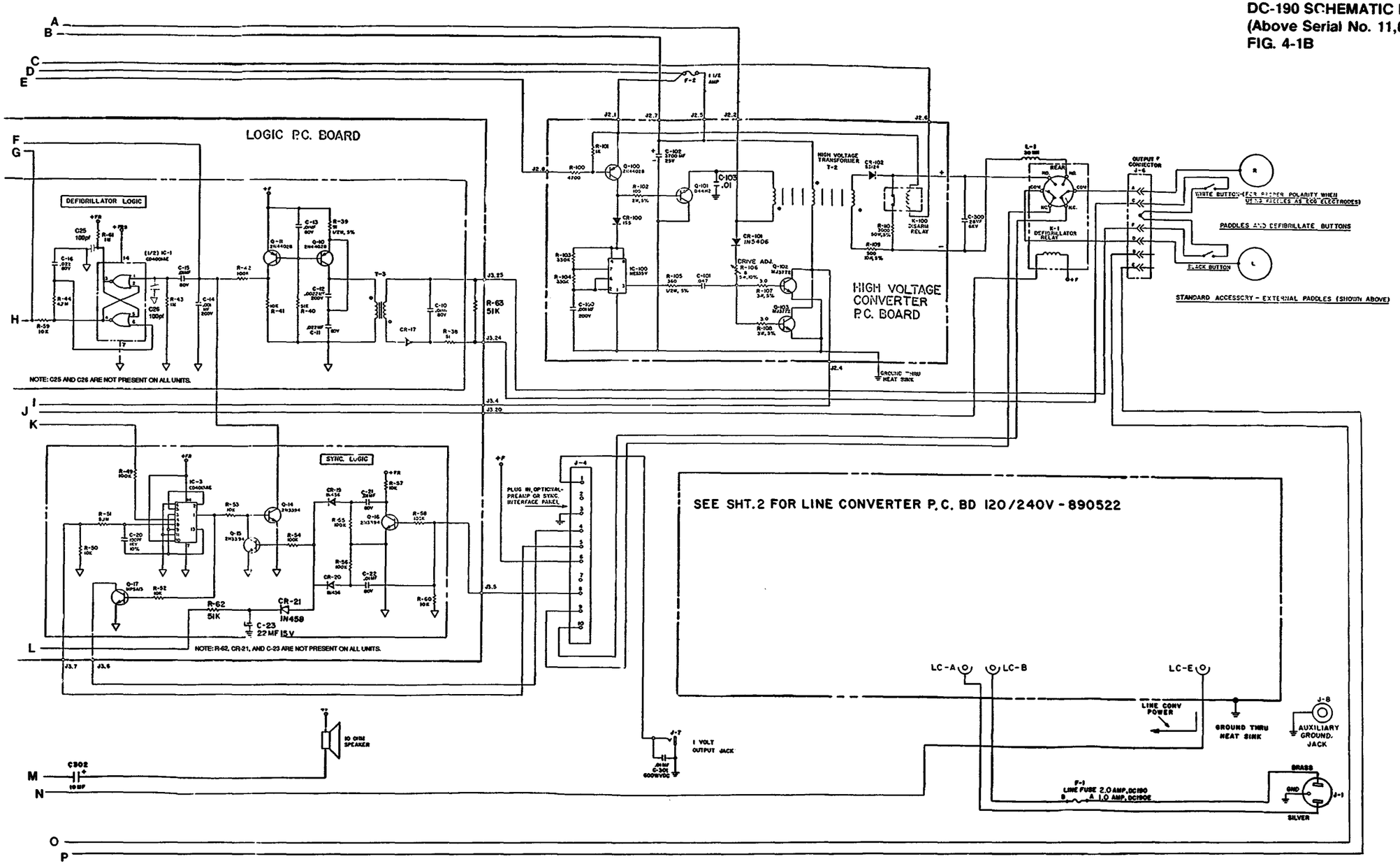
**DC-190 SCHEMATIC DIAGRAM**
**(Above Serial No. 10,000)**
**FIG. 4-1A**



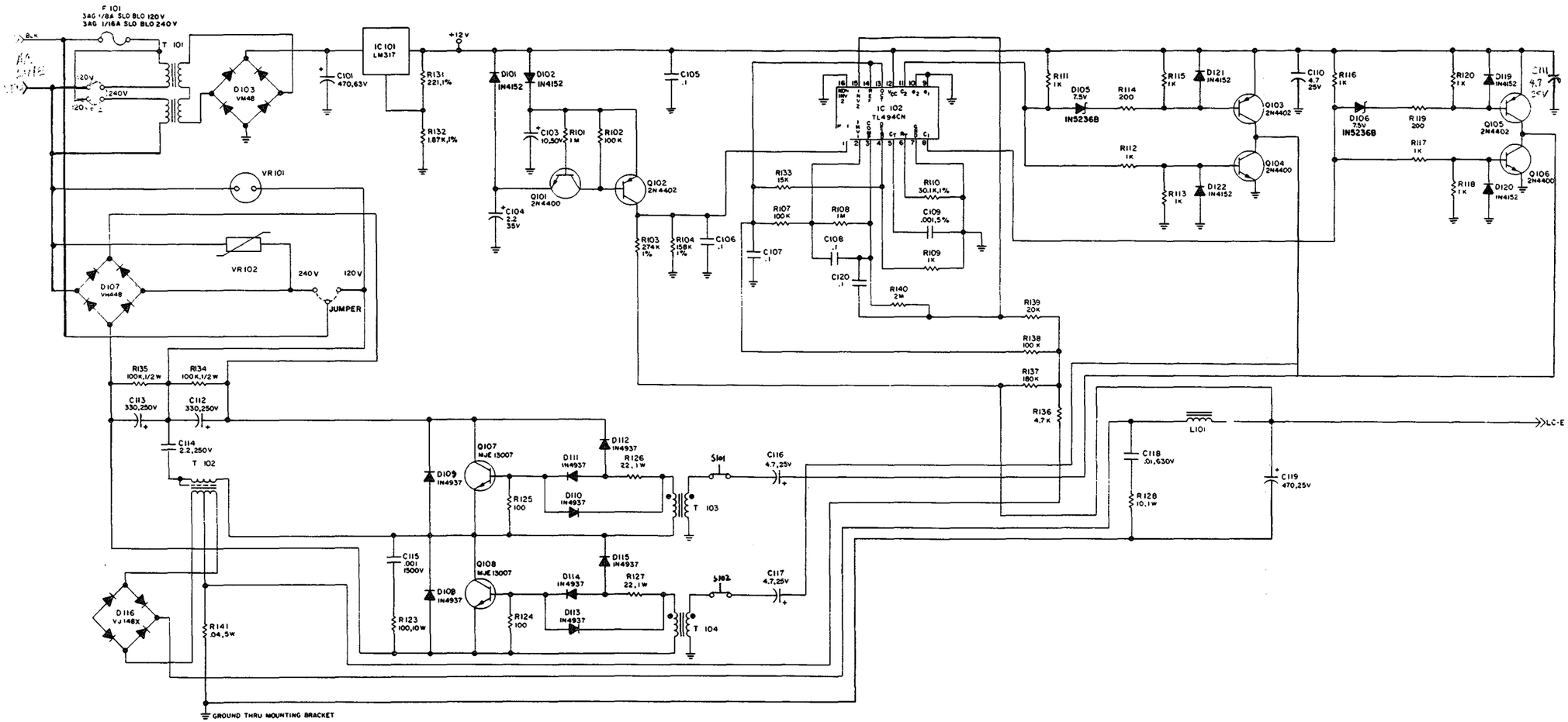
## DC-190 SCHEMATIC DIAGRAM
## (Above Serial No. 11,000)
## FIGURE 4-1B



**DC-190 SCHEMATIC DIAGRAM**
**(Above Serial No. 11,000)**
**FIG. 4-1B**

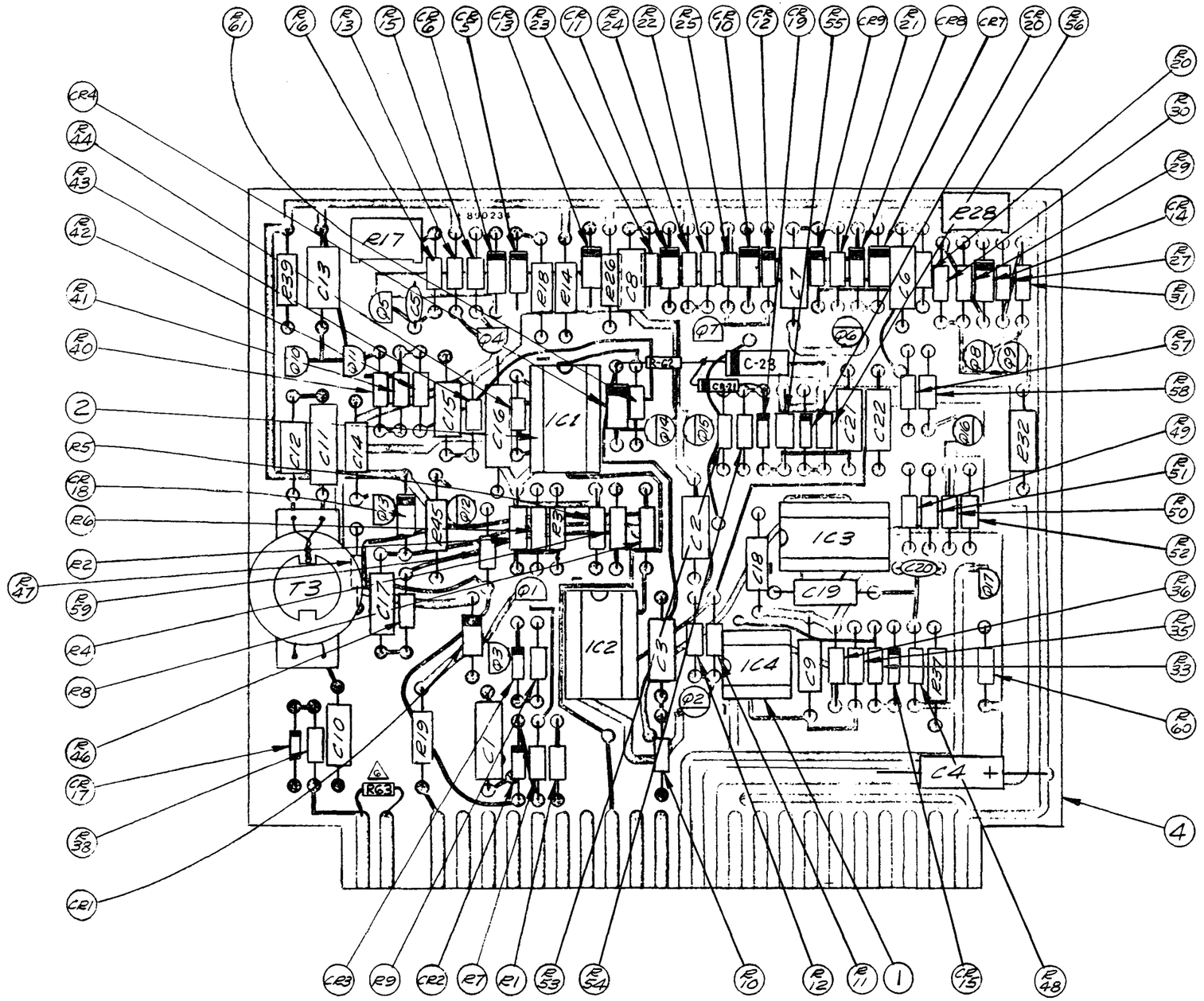


**LINE CONVERTER P.C. BOARD SCHEMATIC**
**(Above Serial No. 11,000)**
**FIG. 4-1C**




**NOTES: UNLESS OTHERWISE SPECIFIED:**

1. RESISTANCE VALUES ARE IN OHMS.
2. CAPACITANCE VALUES ARE IN MICROFARADS.
3. ALL FIXED RESISTORS ARE 1/4 W, 5 %



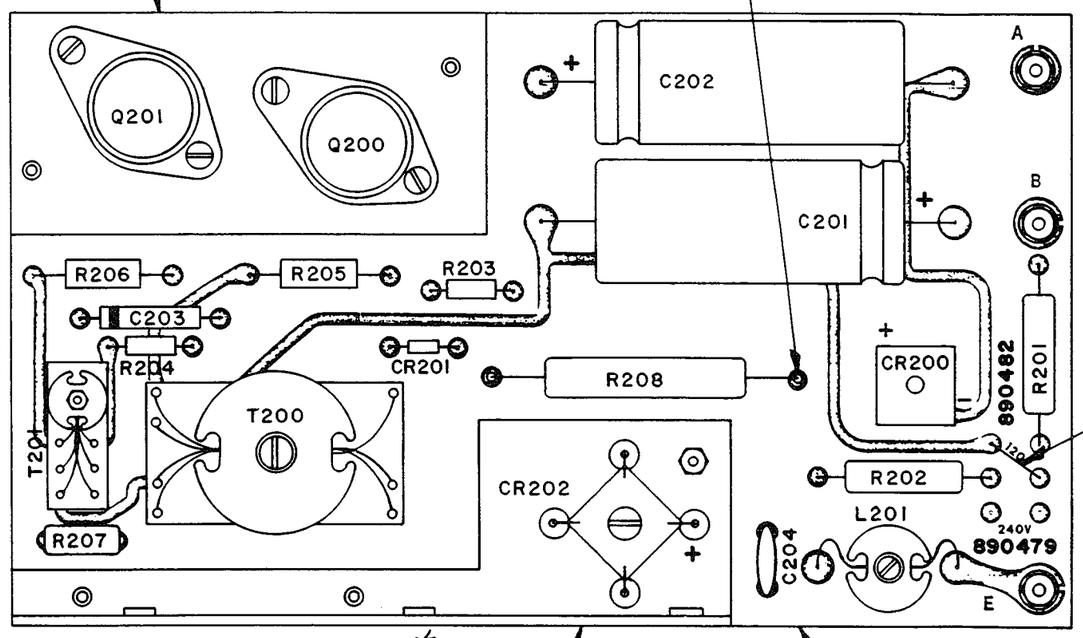

* NOTE: TRANSISTORS MUST BE WITHIN 1/4" FROM BASE TO P.C. BD. "MOUNT AS CLOSE AS POSSIBLE."

| Circuit Symbol | Burdick Part Number |
|---|---|
| CR-1, 7, 10, 18, 17 | 810409 |
| CR-2, 3, 4, 8, 9, 12, 15, 19, 20, 21 | 810413 |
| CR-5 | 810529 |
| CR-6 | 810528 |
| CR-11 | 810533 |
| CR-13 | 810532 |
| CR-14 | 810531 |
| Q-1, 2, 17 | 810537 |
| Q-2, 6, 8, 9, 14, 15, 16 | 810453 |
| Q-4 | 810474 |
| Q-5, 7, 10, 11 | 810462 |
| Q-12 | 810452 |
| Q-13 | 810474 |
| IC-1, IC-2 | 810691 |
| IC-3 | 810541 |
| IC-4 | 810491 |
| C-1, 11, 16 | 813064 |
| C-2, 3, 7, 8, 10, 13, 15, 17, 19, 21, 22 | 813062 |
| C-4 | 812975 |
| C-5, C-20 | 813024 |
| C-6 | 813063 |
| C-9, 14, 18 | 813059 |
| C-12 | 813061 |
| C-23 | 812976 |
| R-1 | 818531 |
| R-2, 5, 6, 7, 9, 11, 23, 25, 31, 41, 50, 52, 53, 57, 59, 60 | 818396 |
| R-3, 4, 8, 10, 21, 42, 46, 49, 54, 55, 56, 58 | 818447 |
| R-12 | 818724 |
| R-13, 30, 36 | 818761 |
| R-14 | 818827 |
| R-15, 20, 35, 40, 62, 63 | 818429 |
| R-16 | 818836 |
| R-17 | 818877 |
| R-18 | 818334 |
| R-19 | 818337 |
| R-22 | 818832 |
| R-24 | 818945 |
| R-26 | 818331 |
| R-27 | 818834 |
| R-28 | 818838 |
| R-29 | 818798 |
| R-32 | 818326 |
| R-33 | 818754 |
| R-37 | 818305 |
| R-38 | 818872 |
| R-39 | 818825 |
| R-43, 47, 61 | 818751 |
| R-44 | 818794 |
| R-45 | 818828 |
| R-51 | 818753 |
| R-48 | 818487 |
| Socket, IC, 8 Pin | 824611 |
| Socket, IC, 14 Pin | 824612 |
| T-3 | 834325 |

**LOGIC PC BOARD**
**DRAWING NUMBER 890234**
**FIGURE 4-2**

(4) # 700218 SCREW, 4-40 x 5/16
BD HD UNDERCUT BRASS NP
(4) # 703102 NUT, 4-40 HEX BRASS NP
(2) # 705504 RIVET, .088 x 3/16
SEMI-TUBULAR BRASS CP
(2) # 845741 INSULATOR,
MICA POWER TRANSISTOR
# 890478 HEATSINK
NOTE: MICA INSULATOR TO BE GREASED ON BOTH SIDES WITH SILICON GREASE AND PLACED BETWEEN TRANSISTOR AND HEATSINK.

(2) # 830016 TERMINAL,
AMP H2567-3




24 GA BARE WIRE

# 700055 SCREW, 2-56 x 1/4
BD HD UNDERCUT BRASS NP
# 700451 SCREW, 6-32 x 1/2
BD HD UNDERCUT BRASS NP
# 703001 NUT, 2-56 HEX BRASS NP
# 703209 NUT, 6-32
HEX KEP STEEL CP
# 705267 WASHER, #2
1202 INT'L LOCK STEEL CP
(2) # 705504 RIVET, .088 x 3/16
SEMI-TUBULAR BRASS CP
# 890477 HEATSINK

NOTE: USE SILICON GREASE BETWEEN RECTIFIER, BRIDGE AND HEATSINK.

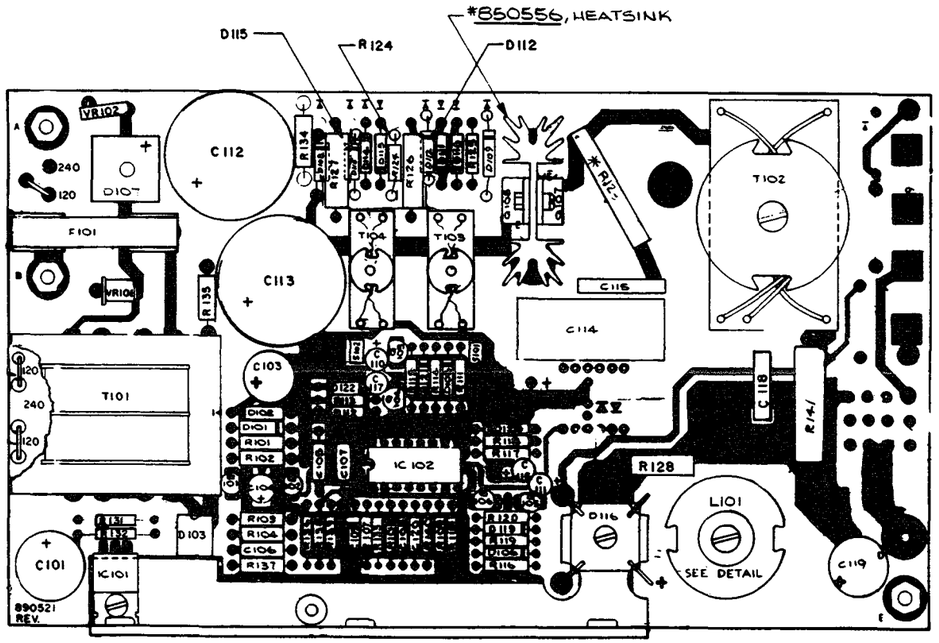
# 890481 P.W. BOARD,
LINE CONVERTER (DC-790)

| ITEM | QTY | PART NO | DESCRIPTION | DESIGNATION |
|---|---|---|---|---|
| | 1 | 810542 | RECTIFIER, BRIDGE | CR200 |
| | 1 | 810634 | DIODE | CR201 |
| | 1 | 810664 | RECTIFIER, BRIDGE | CR202 |
| | 1 | 812922 | CAPACITOR | C203 |
| | 1 | 813068 | CAPACITOR | C204 |
| | 2 | 813093 | CAPACITOR | C201, C202 |
| | 1 | 818317 | RESISTOR, FIXED | R204 |
| | 1 | 818473 | RESISTOR, FIXED | R203 |
| | 2 | 818822 | RESISTOR, FIXED | R201, R202 |
| | 1 | 818982 | RESISTOR, FIXED | R207 |
| | 1 | 818987 | RESISTOR, FIXED | R208 |
| | 2 | 819039 | RESISTOR, FIXED | R205, R206 |
| | 1 | 834345 | INDUCTOR, FILTER | L201 |
| | 1 | 834363 | TRANSFORMER | T201 |
| | 1 | 834376 | TRANSFORMER | T200 |
| | 1 | 890449 | TRANSISTOR | Q200, Q201 |
| | | | (MATCHED PAIR) | |

**LINE CONVERTER P.C. BOARD**
**DRAWING NUMBER 890347**
**SERIAL NOS. ABOVE 6906**
**FIGURE 4-3**

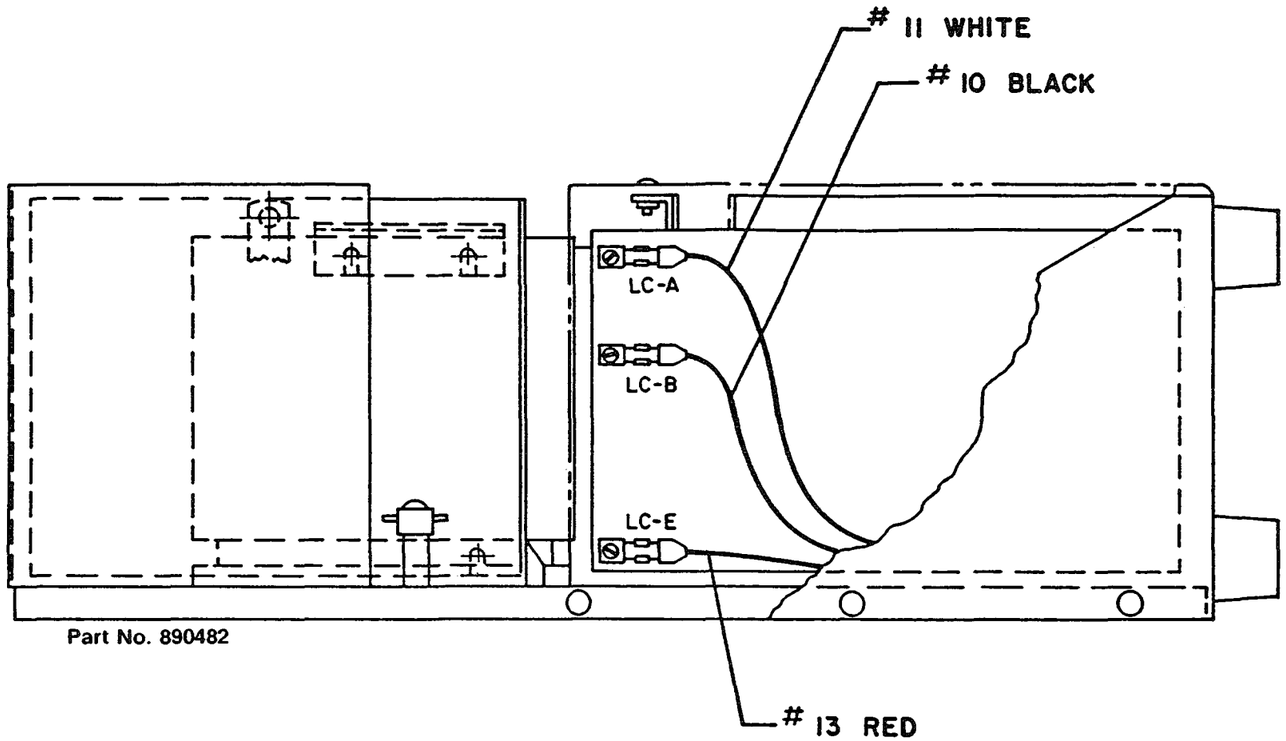
| ITEM | QTY | PART NO | DESCRIPTION | DESIGNATION |
|---|---|---|---|---|
| 1 | | | | |
| 2 | 4 | 813277 | CAPACITOR, TANTALUM 4.7MF, 25V | C110, C111, C116 C117 |
| 3 | 3 | 810462 | TRANSISTOR 2N4402 PNP SILICON | Q102, Q103, Q105 |
| 4 | 6 | 810469 | DIODE IN4152 SILICON | D101, D102, D119, D120, D121, D122, |
| 5 | 3 | 810474 | TRANSISTOR, 2N4400 NPN SILICON | Q101, Q104, Q106 |
| 6 | 1 | 810542 | RECTIFIER, BRIDGE VARO VM402 | D107 |
| 7 | 2 | 810625 | DIODE, IN5236B ZENER 5% | D105, D106, |
| 8 | 1 | 810633 | BRIDGE, SI | D103 |
| 9 | 1 | 810664 | RECTIFIER, BRIDGE | D116 |
| 10 | 1 | 810700 | VOLTAGE REGULATOR | IC101 |
| 11 | 1 | 810764 | SUPPRESSOR, VOLTAGE V250LA20A | VR102 |
| 12 | 1 | 810964 | TUBE 230V GAS DISCHARGE | VR101 |
| 13 | 8 | 810965 | DIODE, IN4937 FAST RECOVERY RECTIFIER | D108 THRU D115 |
| 14 | 2 | 810966 | TRANSISTOR MJE 13007 NPN 8 AMP SWITCHING | Q107, Q108 |
| 15 | 1 | 810967 | IC TL494CN SWITCH MODE PWM CONTROL | IC 102 |
| 16 | 5 | 813148 | CAPACITOR, CERAMIC .1MF 20% 50V | C105, C106, C107, C108, C120 |
| 17 | 1 | 813280 | CAPACITOR, ELECTROLYTIC 470 MF 25 V | C119 |
| 18 | 1 | 812828 | CAPACITOR, ELECTROLYTIC 2.2 MF 20% 10V | C104 |
| 19 | 1 | 813278 | CAPACITOR, ELECTROLYTIC 10 MF 50V | C103 |
| 20 | 1 | 813144 | CAPACITOR, 1000 PF, 100V ±5% POLYCARBONATE | C109 |
| 21 | 1 | 813281 | CAPACITOR, ELECTROLYTIC 470 MF, 63V | C101 |
| 22 | 1 | 813274 | CAPACITOR, MET. POLYEST .01MF, 250 V, 20% | C118, |
| 23 | 2 | 813279 | CAPACITOR, ELECTROLYTIC 330 MF 250V | C112, C113 |
| 24 | 1 | 813276 | CAPACITOR, MET. POLYEST 2.2 MF 250V | C114 |
| 25 | 1 | 813272 | CAPACITOR, MET. POLYEST .001 MF, 1.5KV 20% | C115 |
| 26 | 1 | 834438 | INDCTOR, FILTER | L101 |
| 27 | 2 | 818318 | RESISTOR, FIXED 1SW 5% 100 OHM | R124, R125 |
| 28 | | | | |
| 29 | 1 | 818461 | RESISTOR, FIXED .25W, 5% 180K | R137 |
| 30 | 1 | 818404 | RESISTOR FIXED .25W 5% 15K OHM | R133 |
| 31 | 1 | 819269 | RESISTOR, FIXED .5W 5% .04 OHM | R141 |
| 32 | 2 | 818443 | RESISTOR, FIXED .5W 5% 100K OHM | R134, R135 |
| 33 | 3 | 818447 | RESISTOR, FIXED .25W 5% 100K OHM | R102, R107, R138 |
| 34 | 1 | 819271 | RESISTOR, FIXED 3OW 10% 100 OHM | R122 |
| 35 | 1 | 818506 | RESISTOR, FIXED .25W 5% 2.0M OHM | R140 |
| 36 | 1 | 818726 | RESISTOR, FIXED .25W 5% 4.7K OHM | R136 |
| 37 | 2 | 818751 | RESISTOR, FIXED .25W 5% 1M OHM | R101, R108 |
| 38 | 1 | 818761 | RESISTOR, FIXED .25W 5% 20 K OHM | R139 |
| 39 | 2 | 819270 | RESISTOR, FIXED 1W 5% 22 OHM | R126, R127 |
| 40 | 1 | 818805 | RESISTOR, FIXED .125W 1% 30.1K NASS | R110 |
| 41 | 1 | 818841 | RESISTOR, FIXED 1W 5% 10 OHM CCOMP | R128 |
| 42 | 2 | 818923 | RESISTOR, FIXED .25W 5% 200 OHM | R114, R119 |
| 43 | 9 | 818348 | RESISTOR, FIXED .25W 5% 1K OHM | R111, R112, R113, R115 R116, R117, R118, R120 R109 |
| 44 | 2 | 827955 | SWITCH PRINTED CIRCUIT BOARD SPST | S101, S102 |
| 45 | 1 | 818992 | RESISTOR FIXED .125W 1% 221 OHM NASS | R131 |
| 46 | 1 | 819003 | RESISTOR FIXED .125W 1% 2.49K NASS | R103 |
| 47 | 1 | 819009 | RESISTOR, FIXED .125W 1% 1.87K NASS | R132 |
| 48 | 1 | 818999 | RESISTOR, FIXED .25W 1% 150K NASS | R104 |
| 49 | 2 | 834440 | TRANSFORMER, BASE DRIVE | T103, T104 |
| 50 | 1 | 834439 | TRANSFORMER, LINE CONVERTER | T102 |
| 51 | 1 | 834437 | TRANSFORMER, 120/240V 24VCT-.35A/12V-.5V | T101 |
| 52 | | | | |

**LINE CONVERTER P.C. BOARD**
**(Above Serial No. 11,000)**
**FIG. 4-3A**



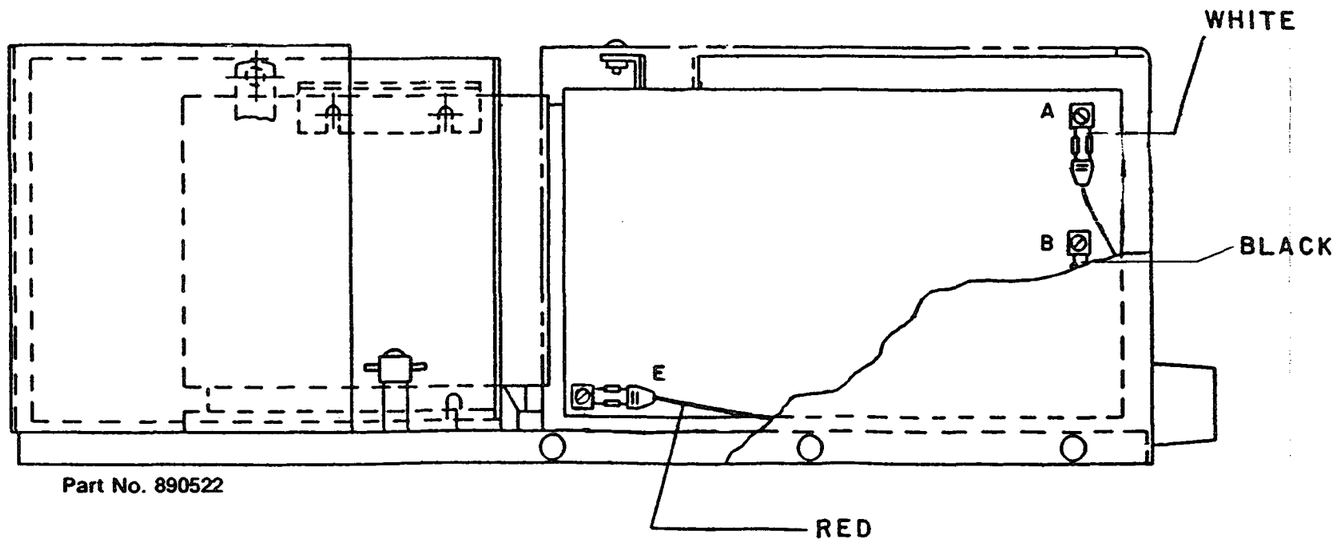

**Part No. 890522**

FIG. 4-4A



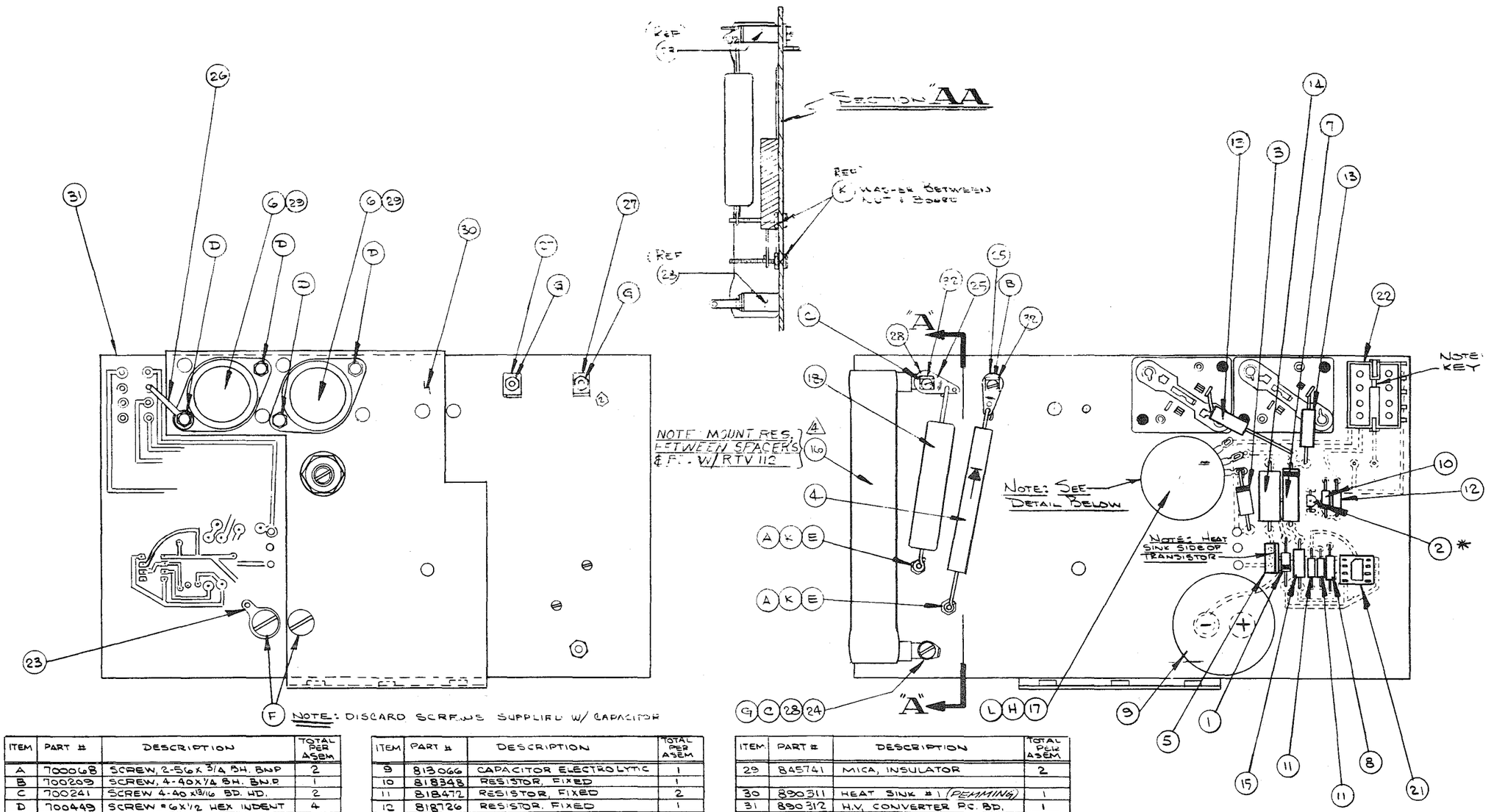

Part No. 890482

FIG. 4-4B
(above serial
no. 11,000)




Part No. 890522

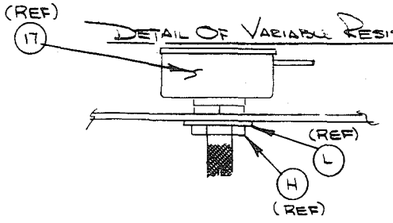
**LINE CONVERTER
PC BOARD
TERMINAL LOCATIONS
FIGURE 4-4**




| ITEM | PART # | DESCRIPTION | TOTAL PER ASSM |
|---|---|---|---|
| A | 700068 | SCREW, 2-56 x 3/4 BH. BNP | 2 |
| B | 700209 | SCREW, 4-40 x 1/4 BH. BN.P | 1 |
| C | 700241 | SCREW 4-40 x 13/16 BD. HD. | 2 |
| D | 700449 | SCREW #6 x 1/2 HEX INDENT | 4 |
| E | 703001 | NUT 2-56 HEX BNP | 2 |
| (3) F | 700966 | SEM, 10-32 x 1/2 | 2 |
| (3) G | 703104 | KEP 4-40 H.S.C. | 3 |
| H | 703901 | NUT 3/8-32 HEX, BNP | 1 |
| K | 705267 | WASHER, #2 INTL LOCK | 2 |
| L | 705277 | WASHER, 3/8 INT'L LOCK | 1 |
| | | | |
| | | | |
| 1 | 810409 | RECTIFIER, SILICON | 1 |
| 2 | 810462 | TRANSISTOR | 1 |
| 3 | 810774 | DIODE, SILICON | 1 |
| 4 | 810527 | DIODE | 1 |
| 5 | 810535 | TRANSISTOR | 1 |
| 6 | 810536 | TRANSISTOR | 2 |
| 7 | 812931 | CAPACITOR, MYLAR | 1 |
| 8 | 813059 | CAPACITOR, FILM | 1 |

| ITEM | PART # | DESCRIPTION | TOTAL PER ASSM |
|---|---|---|---|
| 9 | 813066 | CAPACITOR ELECTROLYTIC | 1 |
| 10 | 818348 | RESISTOR, FIXED | 1 |
| 11 | 818472 | RESISTOR, FIXED | 2 |
| 12 | 818726 | RESISTOR, FIXED | 1 |
| 13 | 818823 | RESISTOR, FIXED | 2 |
| 14 | 818826 | RESISTOR, FIXED | 1 |
| 15 | 818829 | RESISTOR, FIXED | 1 |
| 16 | 818833 | RESISTOR, FIXED | 1 |
| (4) 17 | 819037 | RESISTOR, VARIABLE | 1 |
| 18 | 818854 | RESISTOR, FIXED | 1 |
| | | | |
| | | | |
| 21 | 824611 | I.C. SOCKET | 1 |
| 22 | 824628 | CONNECTOR, HEADER 8-PIN | 1 |
| 23 | 829915 | TERMINAL LUG | 1 |
| 24 | 829916 | TERMINAL LUG | 1 |
| 25 | 829985 | TERMINAL, #4 LUG | 2 |
| 26 | 829903 | TERMINAL LUG | 1 |
| 27 | 830009 | TERMINAL, FASTON | 2 |
| 28 | 844042 | SPACER, ALUM 1/4 O.D x 1/2 LG | 2 |

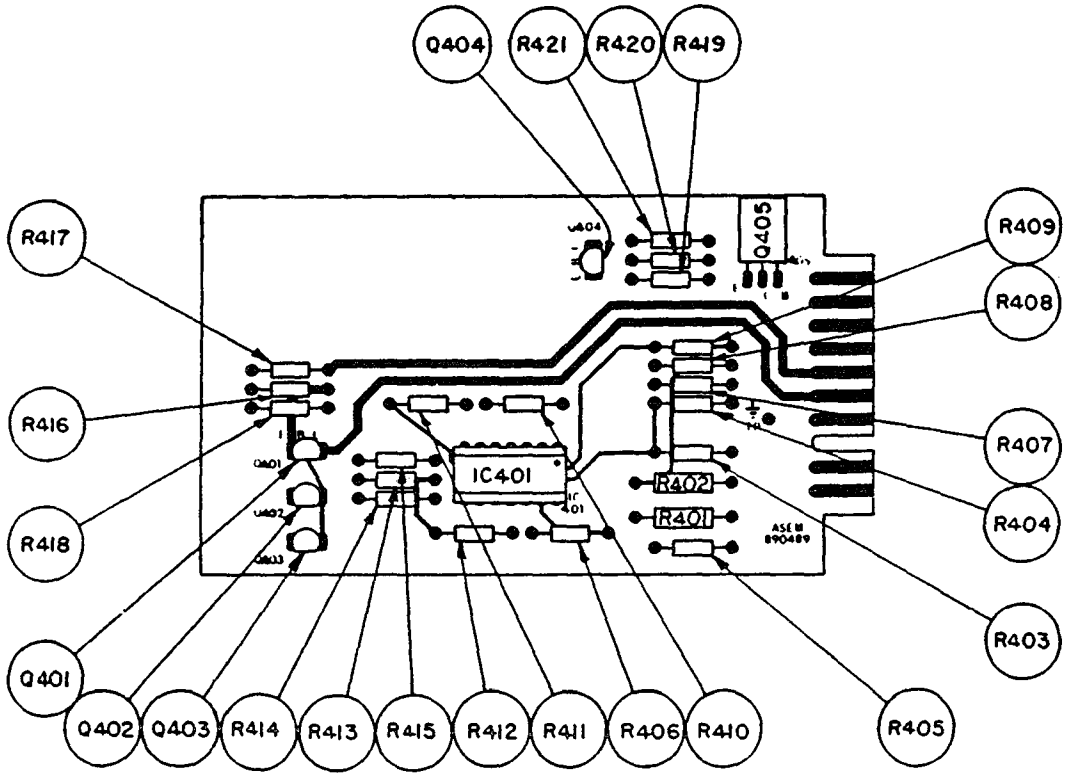
| ITEM | PART # | DESCRIPTION | TOTAL PER ASSM |
|---|---|---|---|
| 29 | 845741 | MICA, INSULATOR | 2 |
| | | | |
| 30 | 890311 | HEAT SINK #1 (REMMING) | 1 |
| 31 | 890312 | H.V. CONVERTER P.C. BD. | 1 |
| | | (RIVETING) | |
| (3) 32 | 830012 | TERMINAL FASTON 90° | 2 |




*NOTE: TRANSISTOR MUST BE WITHIN 1/4" FROM BASE TO P.C. BD. "MOUNT AS CLOSE AS POSSIBLE."

**HIGH VOLTAGE CONVERTER P.C. BOARD DRAWING NUMBER 890291 FIGURE 4-5**

**Notes:**




**CHARGE INHIBIT P.C. BOARD**
**(Above Serial No. 10,000)**
**FIG. 4-5A**

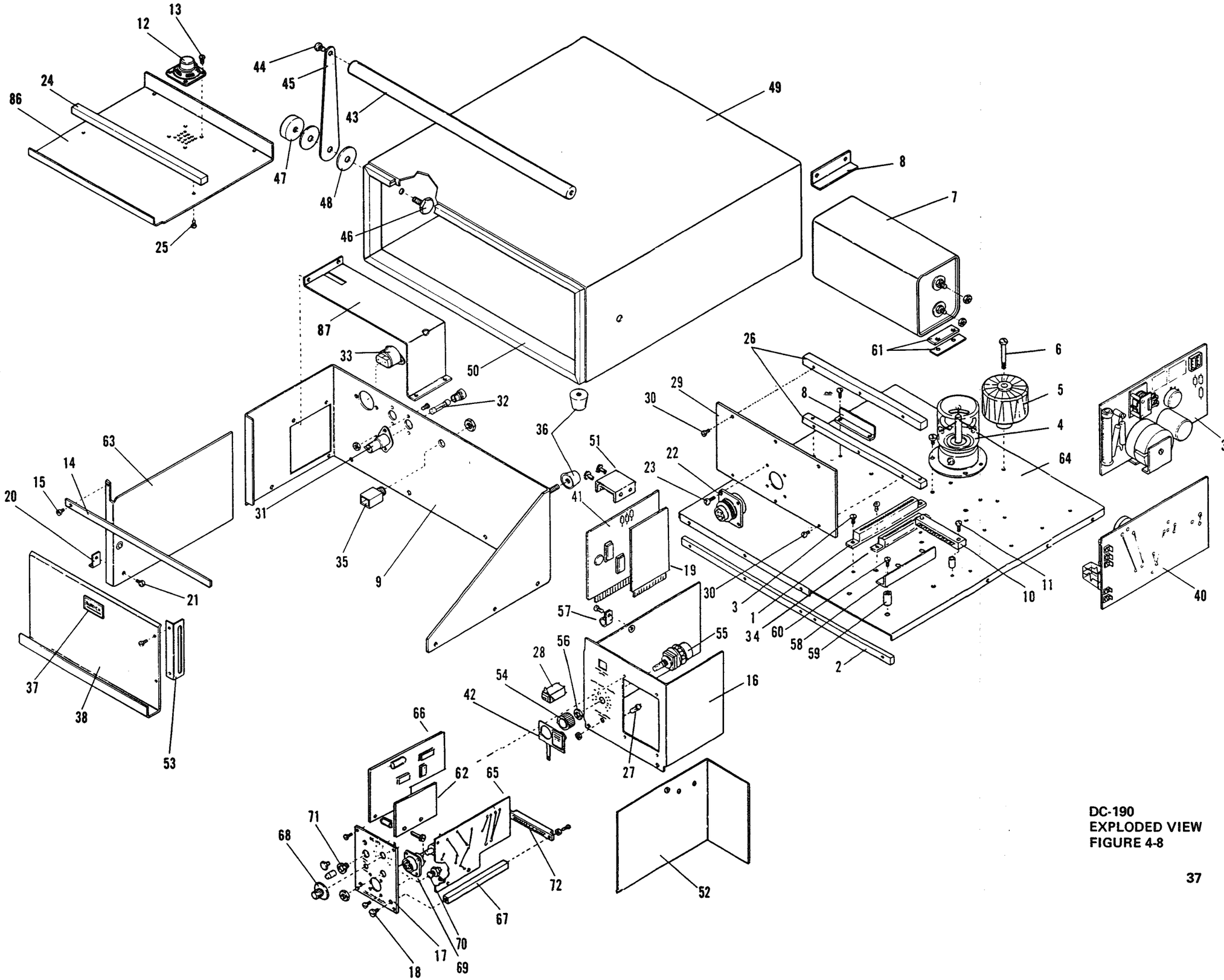
## Charge Inhibit Parts List

| Quantity | Part Number | Description | Designation |
|---|---|---|---|
| 1 | 810583 | Integrated Circuit | IC-401 |
| 1 | 818348 | Resistor, Fixed | R-421 |
| 2 | 818394 | Resistor, Fixed | R-401, R-402 |
| 2 | 818396 | Resistor, Fixed | R-418, R-420 |
| 1 | 818418 | Resistor, Fixed | R-419 |
| 9 | 818426 | Resistor, Fixed | R-407, R-409–R-413, R-415, R-417 |
| 6 | 818447 | Resistor, Fixed | R-403-R-406, R-408, R-414 |
| 1 | 810474 | Transistor | Q-404 |
| 1 | 810686 | Transistor | Q-405 |
| 3 | 810699 | Transistor | Q-401–Q-403 |

# DC-190 PARTS LIST

*(Item numbers keyed to exploded drawings)*

| Item | Part Number | Description |
|---|---|---|
| 1 | 824645 | Connector, J-3 |
| 2 | 890247 | Bar, Front |
| 3 | 700233 | Screw |
| 4 | 833825 | Relay K-1 |
| 5 | 890277 | Choke L-1 |
| 6 | 700984 | Screw 10-32x3 |
| 7 | 813058 | Capacitor |
| 8 | 890268 | Bracket |
| 9 | 890418 | Rear Panel |
| 10 | 824655 | Connector, J-4 |
| 11 | 700243 | Screw 6-32x3/8 |
| 12 | 850303 | Speaker |
| 13 | 700203 | Screw 4-40x1/8 |
| 14 | 890258 | Support Strap |
| 15 | 700204 | Screw 4-40x3/16 |
| 16 | 890508 | Front Panel (360J) |
| | 890417 | Front Panel (400J) |
| 17 | 890435 | Panel |
| 18 | 700204 | Screw 4-40x3/8 |
| 19 | 890489 | Charge Inhibit P.C. Bd. |
| 20 | 870346 | Bracket |
| 21 | 700243 | Screw 6-32x3/8 |
| 22 | 890334 | Connector |
| | 890509 | Connector (above sn10,000) |
| 23 | 700228 | Screw 4-40x3/8 |
| 24 | 890249 | Bar, Center |
| 25 | 700212 | Screw 4-40x1/4 |
| 26 | 890252 | Bar, Compartment, Rear |
| 27 | 831746 | Lamp, DS-1, DS-2, DS-4 |
| 28 | 827838 | Lighted Switch, S-2 |
| 29 | 890265 | Compartment End |
| 30 | 700212 | Screw 4-40x1/4 |
| 31 | 833047 | Fuse Holder |
| 32 | 833013 | Fuse, 1.5A Slow Blow |
| | 833014 | Fuse, 2.0A Slow Blow (above sn11,000) |
| 33 | 824412 | Connector, J-1 |
| 34 | 824438 | Connector, J-12 |
| 35 | 824588 | Connector, J-7 |
| 36 | 850141 | Bumper |
| 37 | 848331 | Burdick Logo |
| 38 | 890433 | Door |
| 39 | 890291 | HV Converter P.C. Bd. |
| 40 | 890482 | Line Converter P.C. Bd. |
| | 890522 | Line Converter P.C. Bd. (above sn11,000) |
| 41 | 890234 | Logic P.C. Board |
| 43 | 890273 | Handle |
| 44 | 701189 | Screw 1/4-20x1/2 |
| 45 | 890271 | Handle Arm |
| 46 | 890274 | Screw |
| 47 | 890272 | Retainer, Handle |
| 48 | 842841 | Washer |
| 49 | 890432 | Wrap-Around Assembly |
| 50 | 890429 | Bezel |
| 51 | 890293 | Hold Down |
| 52 | 890486 | Shield Assembly |
| 53 | 890266 | Door Bracket |
| 54 | 844851 | Knob |
| 55 | 890514 | Switch, S-1 (360J) |
| | 890321 | Switch, S-1 (400J) |
| 56 | 703901 | Nut, 3/8x32 |
| 57 | 850189 | Cable Clip |
| 58 | 880234 | Guide Rail |
| 59 | 844116 | Spacer |
| 60 | 700211 | Screw 4-40x1/4 |
| 61 | 890298 | Assembly, Clamp |
| 62 | 881027 | Paddle Isolation P.C. Bd. |
| 63 | 890423 | Assembly, Side Panel |
| 64 | 890269 | Chassis |
| 65 | 890322 | Preamp P.C. Bd. Assembly |
| 66 | 890323 | Synchronizer P.C. Bd. Assem. |
| 67 | 890324 | Bar, Guide Mount |
| 68 | 844853 | Knob, Rogan, Skirted |
| 69 | 824594 | Conn., 5 Pin Isolated |
| 70 | 827795 | Switch, S-2 |
| 71 | 827831 | Lighted Switch, S-3 |
| 72 | 824656 | Connector, 10 Pin, J-2 |
| 86 | 890264 | Compartment Top |
| 87 | 703226 | Sheet Edge Insert |
| | 007173 | Ground Cord |
| | 007884 | Electrode Gel |
| | 097159 | AC Power Cord |
| | 890427 | Blank Sync. Cover |
| | 890527 | Line Converter Board Kit |
| | 067004 | Paddles, External Adult/Ped. |
| | 824639 | Connector |
| | 890235 | Cap, plug |
| | 890236 | Strain relief |
| | 890562 | Coiled cord |
| | 890612 | Adult electrode base |
| | 890659 | Paddle set, main assm. |




DC-190
EXPLODED VIEW
FIGURE 4-8

# PART V

## DC-195 SYNCHRONIZER

### General

When the SYNC function is selected, the DC-195 acts with the SYNC LOGIC circuitry in the DC-190 to deliver a synchronized countershock coinciding with the occurrence of an R wave.

In the PADDLES position of the lead selector switch, the paddles are used as ECG electrodes. The DC-195 receives an input from the paddles through the N.C. contacts of defibrillator relay K-1. The relay contacts are connected to pins 9 and 10, (K and L), of connector J-4. From J-4 the signal is applied to the preamplifier P.C. board through pins K and L of DC-195 connector J-2.

# OPERATING INSTRUCTIONS

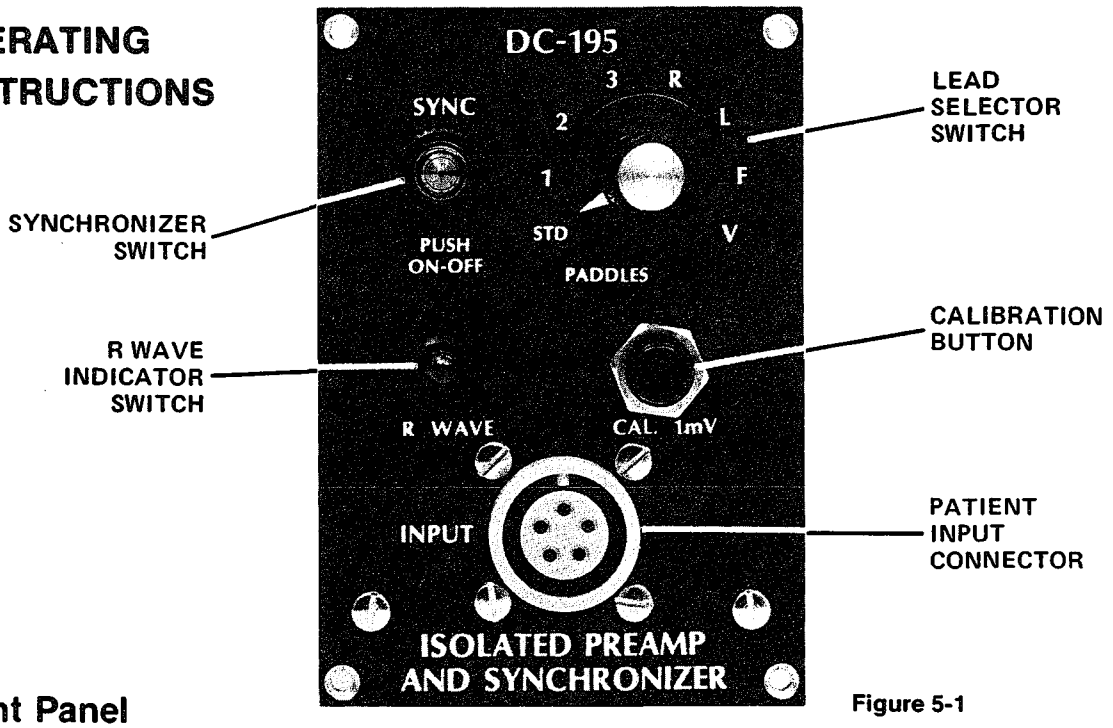



Figure 5-1

## Front Panel DC-195 Synchronizer Controls

**Lead Selector**

9-position switch selects any of six limb leads, a chest lead in V position corresponding to electrode placement, and allows the use of defibrillator paddles as ECG electrodes in the PADDLES position.The STD position permits easier calibration of the system for desired sensitivity. ECG output signals are available on the rear panel marked **Output-Preamp-1V.**

**Sync Button (Push On-Push Off)**

Activates the synchronizer function. The light indicates that the defibrillator is in the SYNC mode. Defibrillator reverts to the defibrillate mode automatically after countershock, or after pushing the sync button and extinguishing the sync light. If additional synchronized countershocks are required, the sync mode must be reactivated each time. Synchronized countershock is available only when the sync light is ON.

In the sync mode a pulse is added to the ECG complex display, and indicates the firing position for countershock. This signal is available at the rear panel jack marked **Output-Preamp-1V** and will be displayed on the monitor connected to this jack.

**Calibrate Button (CAL 1mV)**

When this switch is momentarily depressed, a one millivolt calibrate pulse is applied to the monitor for sensitivity adjustment.

**R-Wave Indicator**

In the SYNC mode, a light blinks when synchronizer detects the presence of an R-wave. This circuit is relatively insensitive to R-wave amplitude, and will provide automatic synchronization for most signal strengths (0.3–3cm peak to peak). When the lead selected does not produce a correct response, select another lead.

**Patient Input Connector**

Connects patient cable to synchronizer.

## Preamplifier Theory of Operation

The patient cable input is applied to J-1. Each active lead has an RF filter. Utilizing the right arm lead as a typical example resistor R-105 and capacitor C-107 serve this function. Diodes CR-9 and CR-10 limit the input amplitude to protect the circuitry during defibrillation. Transistors Q-6 and Q-7 form a unity gain buffer amplifier to provide a high input impedance, typically 50M OHMS, for each active lead. The Right Leg (RL) lead is connected to the common terminal of the isolated power supply to provide a reference. The output of the buffer amplifiers are connected to lead selector switch S-2 which connects the leads in proper combination and polarity to the preamplifier circuit.

Transistors Q-9 and Q-10 form a differential amplifier. This provides common mode rejection to cancel 60 cycle artifacts in conjunction with IC-1. This circuit provides a gain of 25. The output of IC-1 is coupled through C-110, limited by CR-11 and CR-12, and applied to the gate of transistor Q-11.

Transistor Q-11 is a second differential amplifier and with IC-2 forms a DC amplifier having a gain of 40. The output of IC-2 is used to modulate the RF output of Colpitts oscillator Q-12. The modulated RF is coupled to the detector circuitry across high voltage isolation transformer T-1. In the secondary of T-1, CR-19 is used to detect the ECG signal and provides an output equal to 1V per millivolt of input at an offset of approximately +8 volts. This signal is applied to the Synchronizer P.C. Board.

Power for the preamplifier and synchronizer is provided by RF oscillator Q-13 and associated circuitry. The RF signal is coupled across transformer T-2, rectified by CR-15 and CR-16, filtered by C-116 and C-117 and regulated by Zener diodes CR-17 and CR-18.

When the Lead Selector switch is in the PADDLES position, the defibrillator paddles are connected to the Lead Selector switch through J-2.L and J-2.K. Diodes CR-13 and CR-14 rapidly discharge and residual charge remaining on the patient after defibrillation. The rest of the input filter network serves to eliminate DC offset and provide a reference since no right leg lead is attached to the patient.

Power for the paddle isolation circuit is provided by RF oscillator Q801 and associated circuitry. The RF signal is coupled across transformer T-801, rectified by D801-802, filtered by C803-804, and regulated by zener diodes D803-804.

When the Lead Selector switch is in the PADDLES position, the defibrillator paddles are connected to the Lead Selector switch through the paddle isolation circuit and connector pins J-2.L and J-2.K. Diodes D805-806 rapidly discharge any residual charge remaining on the patient after defibrillation. The rest of the input filter network serves to eliminate DC offset and provide a reference, since no right leg lead is attached to the patient.

Differential amplifier IC801, which has a gain of 30, is used to modulate the RF output of Colpitts oscillator Q802. The modulated RF is coupled across high voltage isolation transformer T802. The secondary circuit demodulates the ECG signal and scales it for input to the lead selector switch. Diodes CR13-14 rapidly discharge any residual charge in the circuit after defibrillation. The rest of the input filter network serves to eliminate DC offset and provide a reference for the preamplifier circuit, since no right leg lead is attached to the patient.

## Synchronizer P.C. Board

The ECG complex from the detector circuitry is fed to IC-201, pin 3 and to IC-202, pin 3. IC-201, pins 2, 3 and 4 function as an algebraic adder. The ECG complex and pulse from IC-203, pin 10 which corresponds to the R wave are added and fed to the 1 volt output jack on the DC-190 via J-2.A.

IC-202, pins 2, 3 and 4, form a band pass amplifier. The frequency determining components are resistor R-214 and capacitors C-204 and C-205. The higher frequency components contained in the R wave are amplified to a greater degree than those frequencies contained in the rest of the complex. IC-202, pins 8, 9 and 13, form a "TIMES 6" amplifier. The amplified ECG complex is then fed to IC-201, pin 12.

IC-201, pins 10, 11 and 12 and associated circuitry form a peak detector. The filtered ECG complex on pin 12 is compared to a reference voltage from capacitor C-203 on pin 11. In operation the reference voltage will normally exceed the amplitude of all the components in the ECG complex with the exception of the R wave. The peak detector conducts and charges C-203 through diode CR-202 during the positive going portion of the R wave. As the R wave starts it downward swing, the peak detector cuts off because the voltage on pin 11 exceeds the voltage on pin 12.

IC-201, pins 8, 9 and 13, form a comparator. A reference current of 5 milliamps comes in on pin 13 and holds pin 9 at a nominal 12.5 volts. Pin 8 follows the voltage on IC-201, pin 10. At a point on the positive swing of the R wave corresponding to about 1.5 volts, the current into pin 8 will exceed the reference current and pin 9 will go to 0 volts for a short period of time. The output is a pulse which corresponds to the positive swing of the R wave portion of the ECG complex.

This pulse is fed to IC-203, pin 5. Both halves of IC-203 are configured as 1-shot multivibrators. When the SYNC mode has not been selected, both of the multivibrators are latched in the OFF mode by +12 VDC through DS-2 and R-225. This positive input to pins 4 and 12 results in a logic 1 output from the OR gate which holds the multivibrator output low. When the SYNC switch is pressed, a ground is applied through J-2.D and pins 4 and 12 go to a logic 0.

The pulse from IC-201 pin 9 is applied to pin 5 of IC-203 resulting in a 0 out of the OR gate causing the one-shot to come on for 250 milliseconds. The "on" time of the one-shot is determined by the R-C time constant of resistors R-221, R-222 and capacitor C-207.

Output pin 6 is tied to input pin 4. When pin 6 is positive the OR gate is disabled to lock out any high amplitude T waves which might have turned on the comparator. The output of pin 6 also turns on DS-1 through IC-202, pin 6.

The leading edge of the waveform at pin 6 is differentiated by C-208 and R-223 and fed to IC-203 pin 11. IC-203, pin 10 goes positive for 10 milliseconds. The 10 millisecond pulse is applied to the SYNC LOGIC circuitry of the DC-190 through J-2.H to fire the defibrillator if both paddle buttons are held down, and to pin 2 of the algebraic adder. If a monitor is in use, the R wave segment of the ECG complex will be larger in amplitude due to the addition of the pulse from IC-203, pin 10.

# DC-195 MAINTENANCE PROCEDURES

An extender cable can be locally manufactured utilizing two Amphenol connectors, (Burdick part numbers 824656 and 824655), for servicing the DC-195.

By loosening the two screws holding the guidemount bar, the SYNC board can be tilted to provide access to the test points.

## Removal and Replacement of Synchronizer P.C. Board

1. Loosen the two screws holding the guidemount bar and tilt the SYNC P.C. Board 90 degrees.
2. Mark and remove the 12 leads.
3. Remove the screws holding the SYNC P.C. board to the guidemount bar.
4. Reverse to replace.

## Removal and Replacement of Preamplifier P.C. Board

1. Lower the SYNC P.C. board as described in the preceding section.
2. Remove the skirted knob on the Lead Selector switch.
3. Mark and remove 12 leads.
4. Remove the two screws holding the preamp P.C. board to the guidemount bar.
5. Slide the board to the rear until the lead selector switch shaft is clear, and remove.
6. Reverse to replace.

## Removal and Replacement of Paddle Isolation P.C. Board

1. Remove SYNC P.C. board as previously described.
2. Mark and remove 4 leads.
3. Remove the two screws securing the Paddle Isolation P.C. board to the SYNC P.C. board.
4. Reverse to replace.

# TROUBLESHOOTING

## Check Out Procedure

**Test equipment required: Burdick EKS-91 Electronic Patient or equivalent with patient cable.**

**Procedure**

1. Attach the electronic patient to the DC-195 utilizing the patient cable input. Insure that the electronic patient is on. Rotate the Lead Selector switch to position 1.
2. Remove the paddles from the storage compartment. Insure that they are connected.
3. Rotate the energy selector switch to 35 joules.
4. Press the SYNC button and observe that the SYNC button lights indicating that the DC-195 is energized and that the R wave indicator is flashing.
5. Charge the DC-190 to 35 joules.

**CAUTION:** Hold the defibrillator paddles well clear of your body for steps 6 and 9.

6. Press both paddle buttons. The defibrillator should discharge in coincidence with the flash of the R wave indicator. The SYNC lamp should go out.
7. Turn off the electronic patient and press the SYNC button.
8. Charge the DC-190 to 35 joules.
9. Observing the caution, press both paddle buttons. The defibrillator should not discharge. Press the SYNC button. The sync light should go out and the defibrillator should now discharge normally.
10. Turn the DC-190 off.

**Alternate Procedure:**

**NOTE: This procedure does not check the circuitry prior to the point of calibration pulse insertion. Problems in the buffer amplifiers, lead selector switch, and the first differential amplifier will not be detected. For that reason, it is presented primarily as an aid in troubleshooting.**

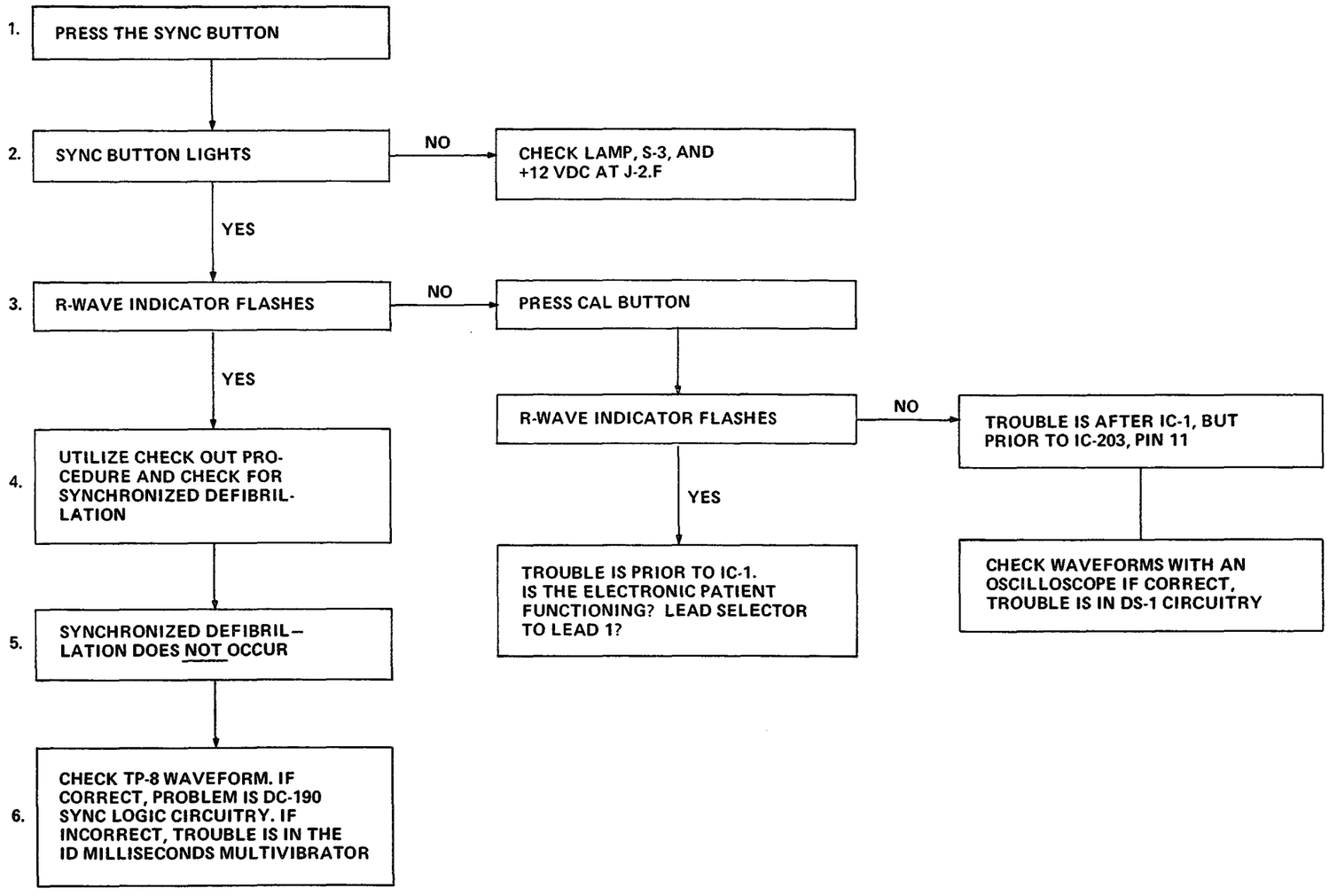
1. Remove the paddles from the storage compartment and insure that they are connected.
2. Rotate the energy selector switch to 35 joules.
3. Press the SYNC button and observe that the SYNC button lights.
4. Rotate the Lead Selector switch to the CAL position.
5. Press the calibration button. The R wave indicator lamp should flash.

**CAUTION:** Hold the defibrillator paddles well clear of your body for step 6. AN ASSISTANT WILL BE REQUIRED.

6. Charge the defibrillator to 35 joules.
7. Observing the caution, press both paddle buttons. The defibrillator should not discharge. While holding the buttons, have your assistant press the calibrate button. The defibrillator should discharge.
8. Turn the DC-190 off.

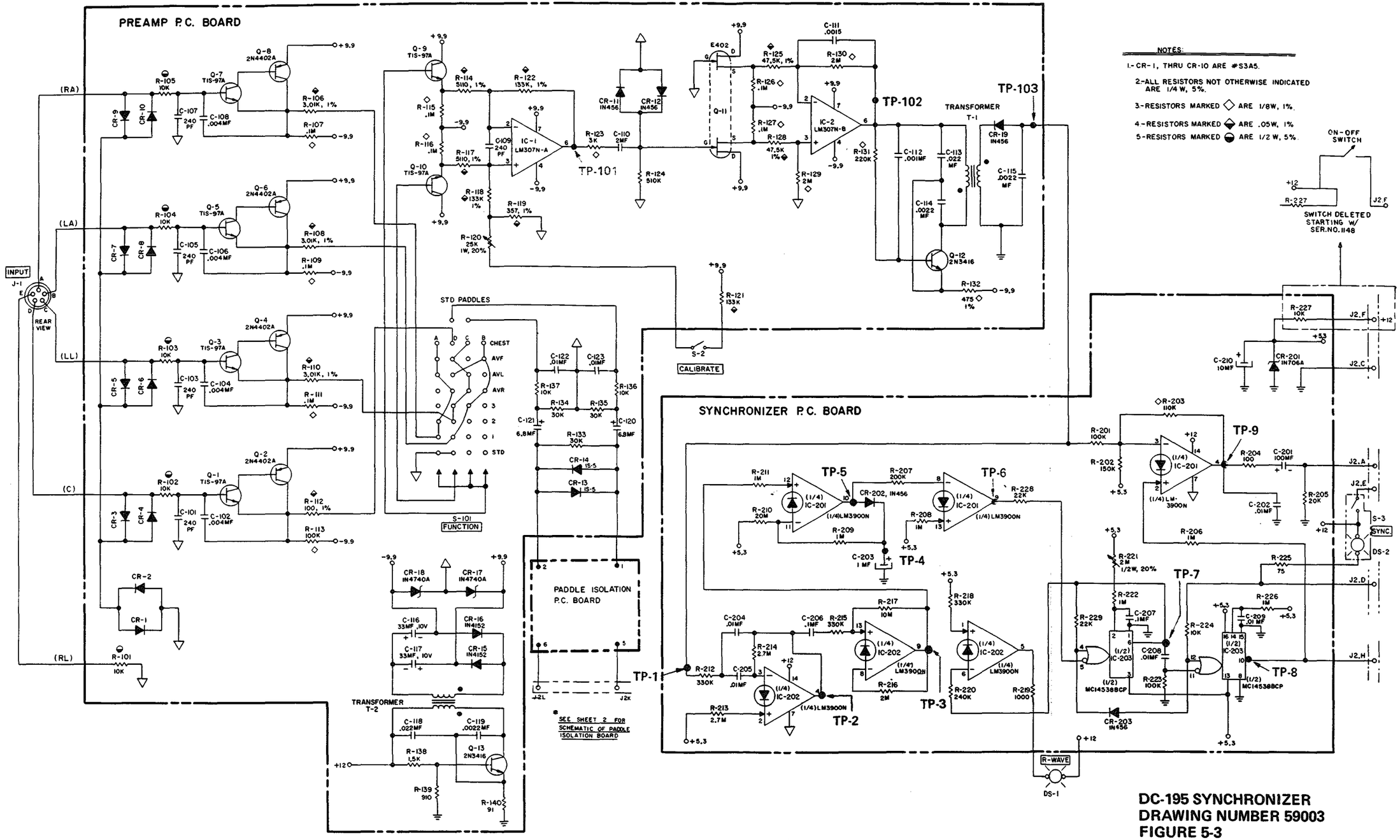
# DC-195 Troubleshooting Chart

SET UP – ATTACH AN ELECTRONIC PATIENT TO THE PATIENT CABLE INPUT. TURN ON THE DC-190. LEAD SELECTOR SWITCH TO POSITION 1. R-WAVE INDICATOR SHOULD FLASH IN POSITIONS 1 THROUGH V OF THE LEAD SELECTOR SWITCH IN STEP 3.

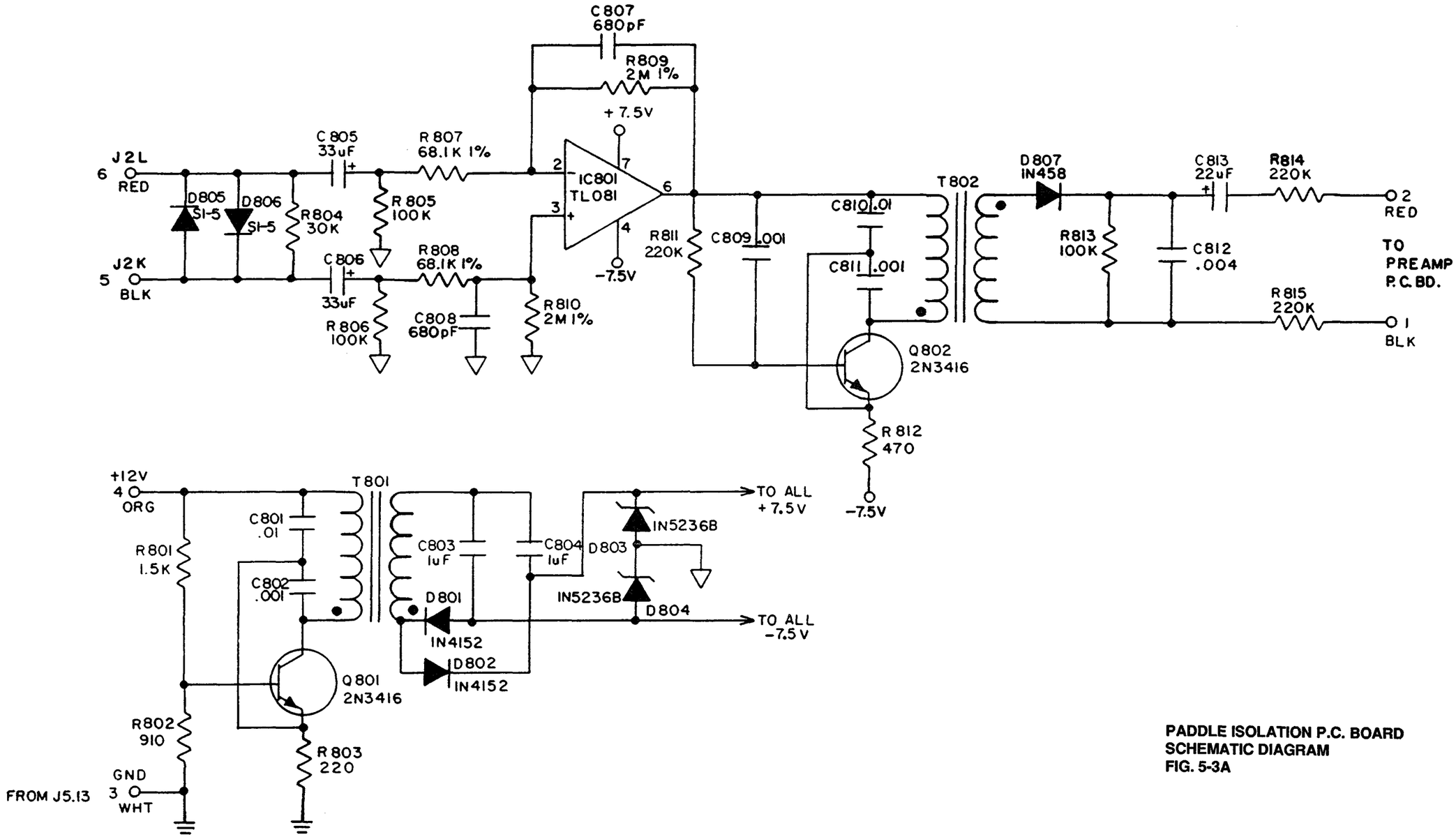

1.
PRESS THE SYNC BUTTON
2.
SYNC BUTTON LIGHTS
NO
CHECK LAMP, S-3, AND +12 VDC AT J-2.F
YES
3.
R-WAVE INDICATOR FLASHES
NO
PRESS CAL BUTTON
YES
R-WAVE INDICATOR FLASHES
NO
TROUBLE IS AFTER IC-1, BUT PRIOR TO IC-203, PIN 11
YES
TROUBLE IS PRIOR TO IC-1. IS THE ELECTRONIC PATIENT FUNCTIONING? LEAD SELECTOR TO LEAD 1?
CHECK WAVEFORMS WITH AN OSCILLOSCOPE IF CORRECT, TROUBLE IS IN DS-1 CIRCUITRY
4.
UTILIZE CHECK OUT PROCEDURE AND CHECK FOR SYNCHRONIZED DEFIBRILLATION
5.
SYNCHRONIZED DEFIBRILLATION DOES NOT OCCUR
6.
CHECK TP-8 WAVEFORM. IF CORRECT, PROBLEM IS DC-190 SYNC LOGIC CIRCUITRY. IF INCORRECT, TROUBLE IS IN THE ID MILLISECONDS MULTIVIBRATOR

TROUBLESHOOTING CHART
FIGURE 5-2

**Notes:**




**DC-195 SYNCHRONIZER**
**DRAWING NUMBER 59003**
**FIGURE 5-3**

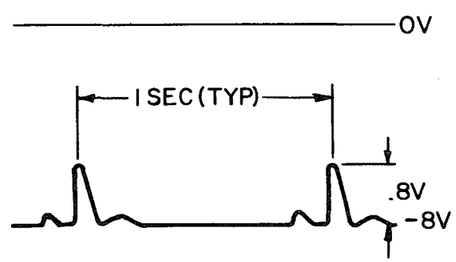



**PADDLE ISOLATION P.C. BOARD**
**SCHEMATIC DIAGRAM**
**FIG. 5-3A**

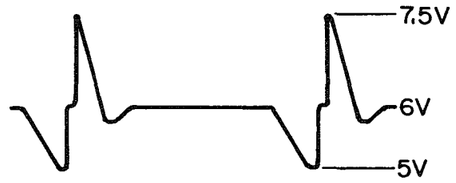
## Waveforms

**Taken with a Burdick EKS-91 Electronic Patient, Sweep Speed .2m/sec, Lead Selector TO R.**

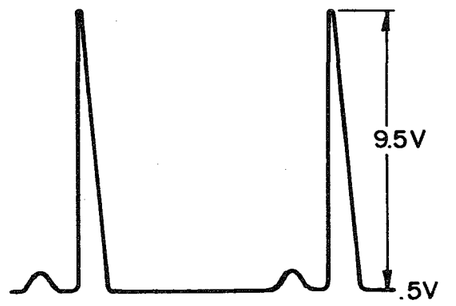
**TP-1**
R-212
1V/CM DC



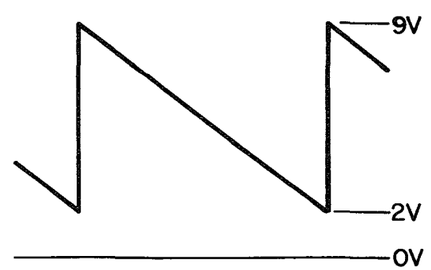

**TP-2**
IC-202 PIN 4
1V/CM DC




**TP-3**
IC-202 PIN 9
5V/CM DC



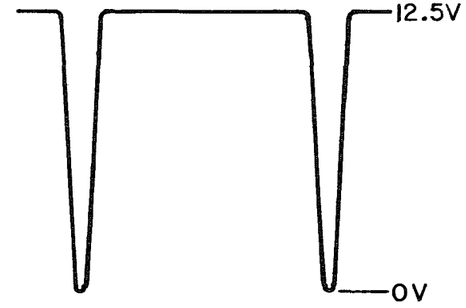

**TP-4**
C-203
5V/CM DC



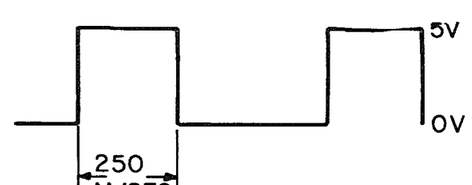

**TP-5**
IC-201 PIN 10
5V/CM DC



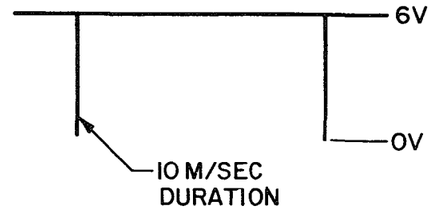

**TP-6**
IC-201 PIN 9
5V/CM DC



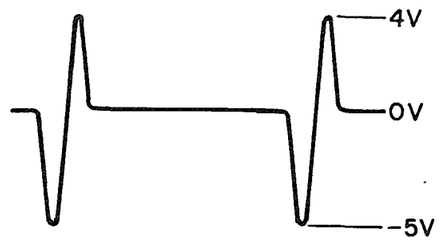

**TP-7**
IC-203 PIN 6
5V/CM DC




**TP-8**
IC-203 PIN 10
5V/CM DC




**TP-9**
IC-201 PIN 4
1V/CM DC

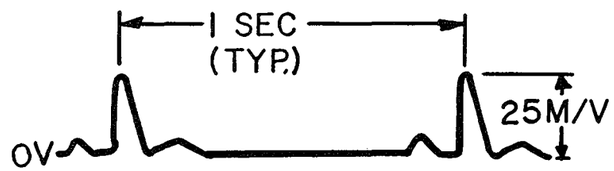



**WAVEFORMS**
**FIGURE 5-4**

## Waveforms

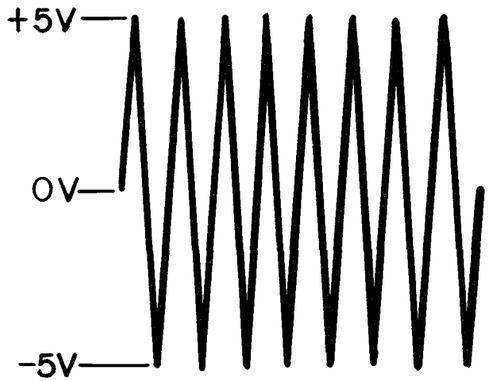
**TP-101**
C-110
.2 SEC/CM
20MV/CM DC

**Taken with a Burdick EKS-91 Electronic Patient, Ground Probe to CR-11 Cathode.**

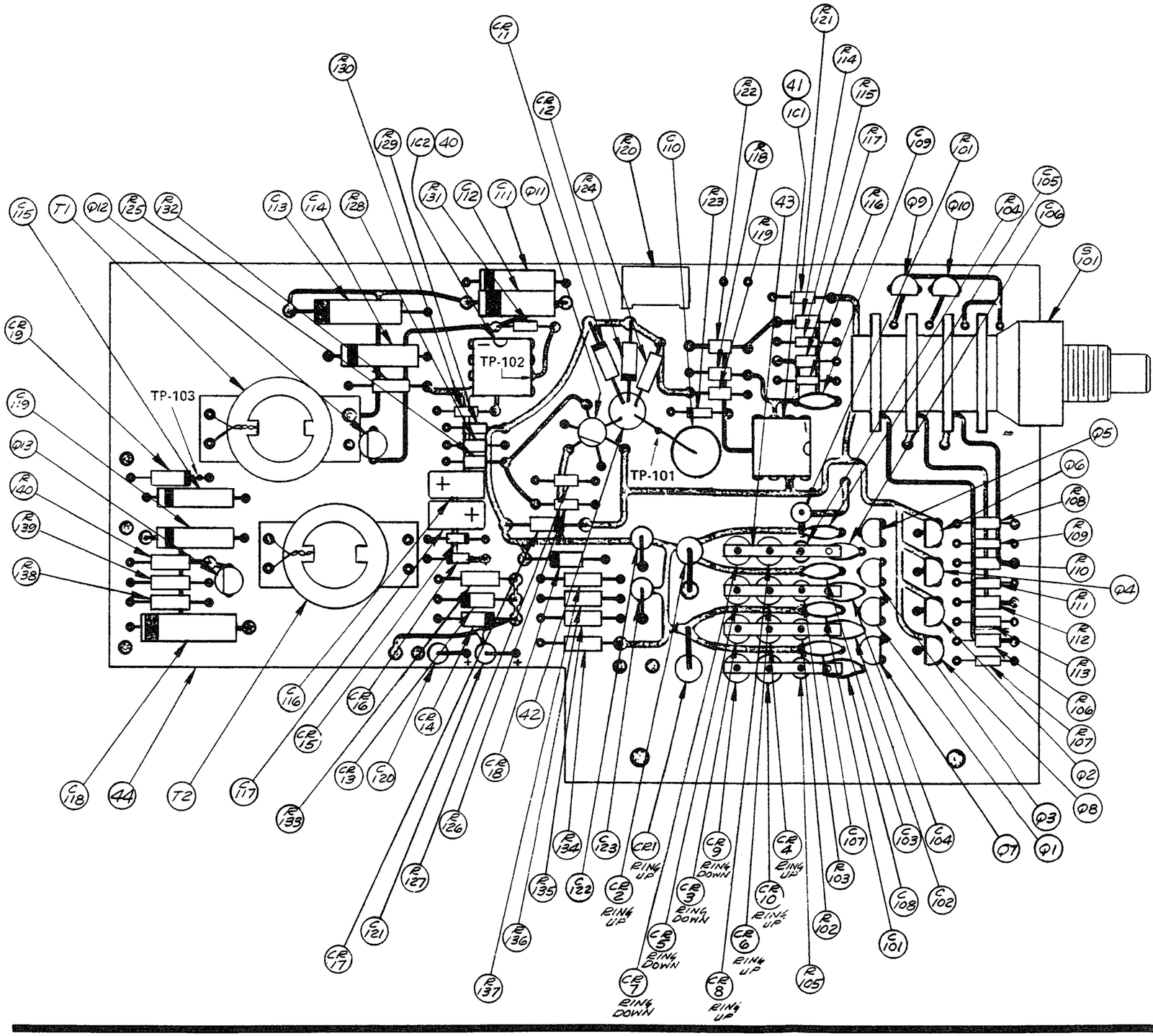



**TP-102**
IC-2 PIN 6
.2 SEC/CM
.5V/CM DC

**TP-103**
CR-19 CATHODE
SYNC. EXTERNALLY TO
COLLECTOR OF Q-12 (C-114)
10 MICRO SEC/CM
5V/CM

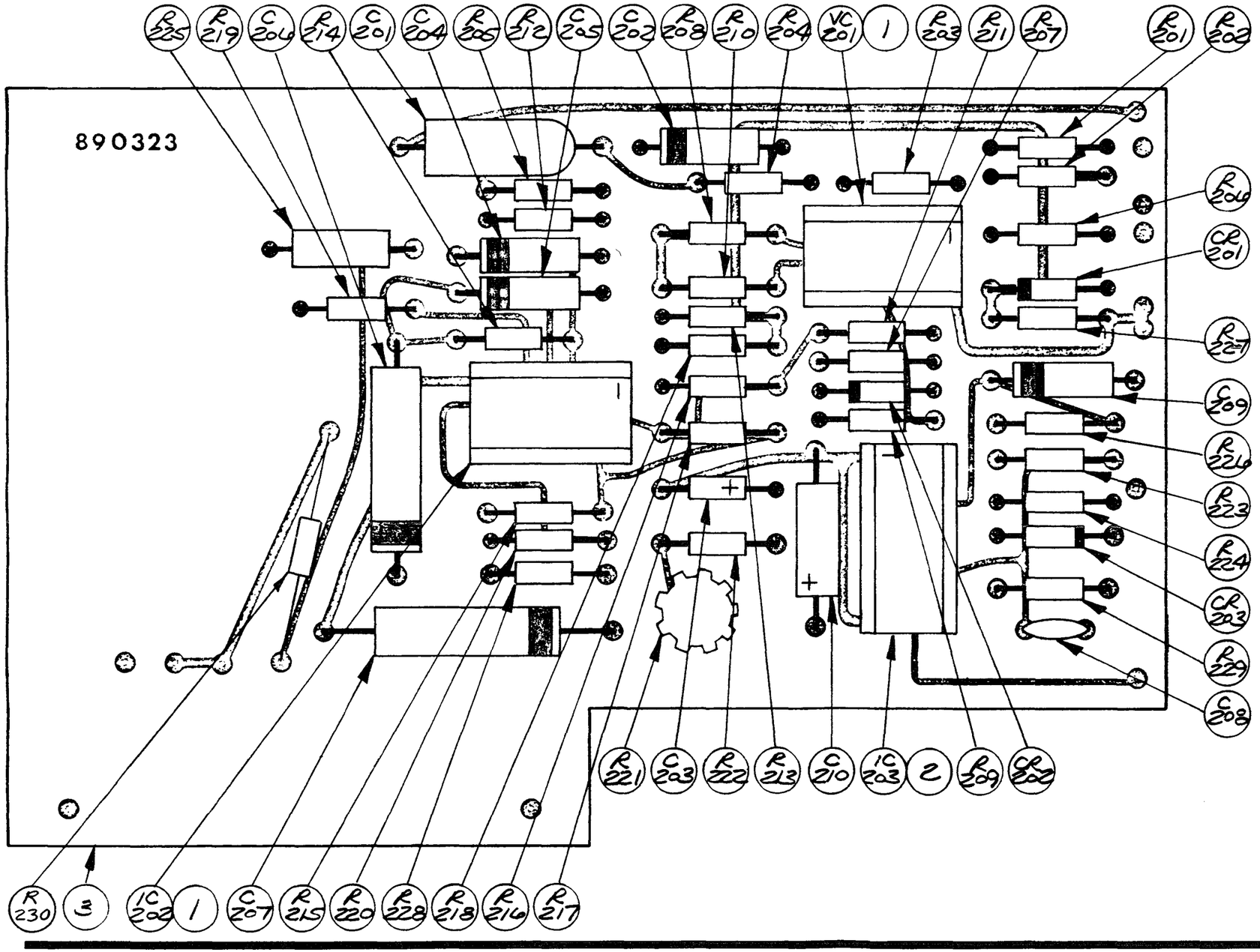



**WAVEFORMS**
**FIGURE 5-5**



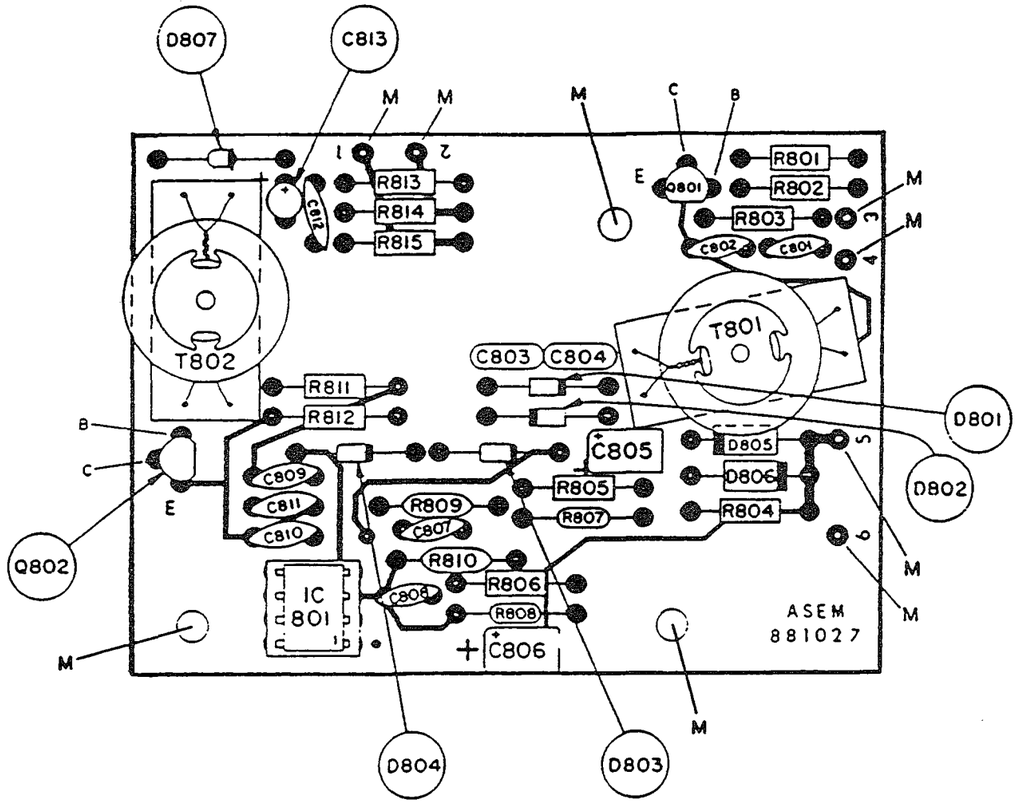

| Circuit Symbol | Burdick Part Number |
|---|---|
| CR-1, 2, 3, 4, 5, 6, 7, 8, 9 10 | 810479 |
| CR-11, 12, 19 | 810413 |
| CR-13, CR-14 | 810409 |
| CR-15, CR-16 | 810469 |
| CR-17, CR-19 | 810473 |
| IC-1 | 810548 |
| IC-2 | 810515 |
| Q-1, 3, 5, 7, 9, 10 | 810699 |
| Q-2, 4, 5, 8 | 810545 |
| Q-11 | 810496 |
| Q-12, Q-13 | 810454 |
| C-101, 103, 105, 107, 109 | 813003 |
| C-102, 104, 106, 108 | 813034 |
| C-110 | 813032 |
| C-111 | 813086 |
| C-112 | 812906 |
| C-113, C-118 | 812922 |
| C-114, 115, 119 | 813022 |
| C-116, C-117 | 813033 |
| C-120, C-121 | 812974 |
| C-122, C-123 | 812918 |
| R-101, 102, 103, 104, 105 | 818394 |
| R-106, 108, 110 | 818858 |
| R-107, 109, 113, 115, 116, 126, 127 | 818864 |
| R-112 | 818856 |
| R-114, R-117 | 818859 |
| R-118, 121, 122 | 818855 |
| R-119 | 818857 |
| R-120 | 818647 |
| R-123 | 818862 |
| R-124 | 818485 |
| R-125, R-128 | 818861 |
| R-129, R-130 | 818866 |
| R-131 | 818865 |
| R-132 | 818738 |
| R-133, 134, 135 | 818792 |
| R-136, R-137 | 818396 |
| R-138 | 818723 |
| R-139 | 818722 |
| R-140 | 818719 |
| Socket, IC 8 Pin | 824611 |
| S-101 | 827829 |
| T-1, T-2 | 834325 |

**DC-195 PREAMPLIFIER P.C. BOARD**
**DRAWING NUMBER 890322**
**FIGURE 5-6**




| Circuit Symbol | Burdick Part Number |
|---|---|
| CR-201 | 810471 |
| CR-202, 203 | 810413 |
| IC-201, IC-202 | 810551 |
| IC-203 | 810607 |
| C-201 | 813047 |
| C-202, 204, 205, 209 | 812918 |
| C-203 | 813077 |
| C-206, C-207 | 813015 |
| C-208 | 813054 |
| C-210 | 812837 |
| R-201, R-223 | 818447 |
| R-202 | 818457 |
| R-203 | 818821 |
| R-204 | 818318 |
| R-205 | 818761 |
| R-206, 208, 211, 222, 226 | 818751 |
| R-207 | 818463 |
| R-209 | 818494 |
| R-210 | 818531 |
| R-212, 215, 218 | 818472 |
| R-213, R-214 | 818509 |
| R-216 | 818506 |
| R-217 | 818754 |
| R-219 | 818348 |
| R-220 | 818466 |
| R-221 | 818897 |
| R-224 | 818396 |
| R-225 | 818788 |
| R-227 | 818339 |
| R-228, R-229 | 818411 |
| R-230 | 818348 |
| Socket, IC, 14 Pin | 824612 |
| Socket, IC, 16 Pin | 824613 |

**DC-195 SYNCHRONIZER**
**P.C. BOARD**
**DRAWING NUMBER B-890323**
**FIGURE 5-7**




## Paddle Isolation Parts List

| Quantity | Part Number | Description | Designation |
|---|---|---|---|
| 3 | 812808 | Capacitor | C-802, C-809, C-811 |
| 2 | 813033 | Capacitor | C-805, C-806 |
| 1 | 813034 | Capacitor | C-812 |
| 2 | 813054 | Capacitor | C-801, C-810 |
| 2 | 813057 | Capacitor | C-807, C-808 |
| 1 | 813134 | Capacitor | C-813 |
| 2 | 813140 | Capacitor | C-803, C-804 |
| 2 | 810409 | Diode | D-805, D-806 |
| 1 | 810413 | Diode | D-807 |
| 2 | 810469 | Diode | D-801, D-802 |
| 2 | 810625 | Diode | D-803, D-804 |
| 1 | 810647 | Integrated Circuit | IC-801 |
| 1 | 818325 | Resistor, Fixed | R-803 |
| 1 | 818333 | Resistor, Fixed | R-812 |
| 3 | 818447 | Resistor, Fixed | R-805, R-806, R-813 |
| 1 | 818722 | Resistor, Fixed | R-802 |
| 1 | 818723 | Resistor, Fixed | R-801 |
| 3 | 818732 | Resistor, Fixed | R-811, R-814, R-815 |
| 1 | 818792 | Resistor, Fixed | R-804 |
| 2 | 818811 | Resistor, Fixed | R-807, R-808 |
| 2 | 818974 | Resistor, Fixed | R-809, R-810 |
| 2 | 834325 | Transformer | T-801, T-802 |
| 2 | 810454 | Transistor | Q-801, Q-802 |

**PADDLE ISOLATION P.C. BOARD**
**FIG. 5-8**

**Notes:**

**Notes:**

SIEMENS

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